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ART. I.—*A letter to Prof. Faraday, on certain Theoretical Opinions;* by R. HARE, M D., Professor of Chemistry in the University of Pennsylvania.*

Dear Sir,—I have been indebted to your kindness for several pamphlets comprising your researches in electricity, which I have perused with the greatest degree of interest.

You must be too well aware of the height at which you stand, in the estimation of men of science, to doubt that I entertain with diffidence, any opinion in opposition to yours. I may say of you as in a former instance of Berzelius, that you occupy an elevation inaccessible to unjustifiable criticism. Under these circumstances, I hope that I may, from you, experience the candor and kindness which were displayed by the great Swedish chemist in his reply to my strictures on his nomenclature.

I am unable to reconcile the language which you hold in paragraph 1615, with the fundamental position taken in 1155. Agreeably to the latter, you believe ordinary induction to be the action of *contiguous* particles, consisting of a species of polarity, instead

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* *To the Editors of the American Journal of Science and Arts,*—GENTLEMEN: I avail myself of the medium of your Journal to address to the celebrated Faraday, a letter on the subject of certain hypothetical inferences which he has made from his late ingenious experimental researches. R. H.

of being an action of either particles or masses at "*sensible distances.*" Agreeably to the former, you conceive that "assuming that a perfect vacuum was to intervene in the course of the line of inductive action, it does not follow from this theory that the line of particles on opposite sides of such a vacuum would not act upon each other." Again, supposing "it possible for a positively electrified particle to be in the centre of a vacuum an inch in diameter, nothing in my present view forbids that the particle should act at a distance of half an inch on all the particles forming the disk of the inner superficies of the bounding sphere."

Laying these quotations before you for reconsideration, I beg leave to inquire how a positively excited particle, situated as above described, can react "inductrically" with any particles in the superficies of the surrounding sphere, if this species of reaction require that the particles between which it takes place be contiguous. Moreover if induction be not "an action either of particles or masses at *sensible* distances," how can a particle situated as above described, "*act at the distance of half an inch on all the particles forming the disk of the inner superficies of the bounding sphere?*" What is a sensible distance, if half an inch is not?

How can the force thus exercised obey the "well known law of the squares of the distances," if as you state (1375) the rarefaction of the air does not alter the intensity of the inductive action? In proportion as the air is rarefied, do not its particles become more remote?

Can the ponderable particles of a gas be deemed contiguous in the true sense of this word, under any circumstances? And it may be well here to observe, that admitting induction to arise from an affection of intervening ponderable atoms, it is difficult to conceive that the intensity of this affection will be inversely as their number as alleged by you. No such law holds good in the communication of heat. The air in contact with a surface at a constant elevation of temperature, such for instance as might be supported by boiling water, would not become hotter by being rarefied, and consequently could not become more efficacious in the conduction of heat from the heated surface to a colder one in its vicinity.

As soon as I commenced the perusal of your researches on this subject, it occurred to me that the passage of electricity through a vacuum, or a highly rarefied medium, as demonstrated by vari-

ous experiments, and especially those of Davy, was inconsistent with the idea that ponderable matter could be a necessary agent in the process of electrical induction. I therefore inferred that your efforts would be primarily directed to a re-examination of that question.

If induction, in acting through a vacuum, be propagated in right lines, may not the curvilinear direction which it pursues, when passing through "dialectrics," be ascribed to the modifying influence which they exert?

If, as you concede, electrified particles on opposite sides of a vacuum can act upon each other, wherefore is the received theory of the mode in which the excited surface of a Leyden jar induces in the opposite surface, a contrary state, objectionable?

As the theory which you have proposed, gives great importance to the idea of polarity, I regret that you have not defined the meaning which you attach to this word. As you designate that to which you refer, as a "species of polarity," it is presumable that you have conceived of several kinds with which ponderable atoms may be endowed. I find it difficult to conceive of any kind which may be capable of as many degrees of intensity as the known phenomena of electricity require; especially according to your opinion that the only difference between the fluid evolved by galvanic apparatus and that evolved by friction, is due to opposite extremes in quantity and intensity; the intensity of electrical excitement producible by the one, being almost infinitely greater than that which can be produced by the other. What state of the poles can constitute quantity—what other state intensity, the same matter being capable of either electricity, as is well known to be the fact? Would it not be well to consider how, consistently with any conceivable polarization, and without the assistance of some imponderable matter, any great difference of intensity in inductive power, can be created?

When by friction the surface is polarized so that particles are brought into a state of constraint from which they endeavor to return to their natural state, if nothing be superadded to them, it must be supposed that they have poles capable of existing in two different positions. In one of these positions, dissimilar poles coinciding, are neutralized; while in the other position, they are more remote, and consequently capable of acting upon other matter.

But I am unable to imagine any change which can admit of gradations of intensity, *increasing* with remoteness. I cannot figure to myself any reaction which increase of distance would not lessen. Much less can I conceive that such extremes of intensity can be thus created, as those of which you consider the existence as demonstrated. It may be suggested that the change of polarity produced in particles by electrical inductions, may arise from the forced approximation of reciprocally repellent poles, so that the intensity of the inductive force, and of their effort to return to their previous situation, may be susceptible of the gradation which your electrical doctrines require. But could the existence of such a repellent force be consistent with the mutual cohesion which appears almost universally to be a property of ponderable particles? I am aware that, agreeably to the ingenious hypothesis of Mossotti, repulsion is an inherent property of the particles which we call ponderable; but then he assumes the existence of an imponderable fluid to account for cohesion; and for the necessity of such a fluid to account for induction it is my ultimate object to contend. I would suggest that it can hardly be expedient to ascribe the phenomena of electricity to the polarization of ponderable particles, unless it can be shown that if admitted, it would be competent to produce all the known varieties of electric excitement, whether as to its nature or energy.

If I comprehend your theory, the opposite electrical state induced on one side of a coated pane, when the other is directly electrified, arises from an affection of the intervening vitreous particles, by which a certain polar state caused on one side of the pane, induces an opposite state on the other side. Each vitreous particle having its poles severally in opposite states, they are arranged as magnetized iron filings in lines; so that alternately opposite poles are presented in such a manner that all of one kind are exposed at one surface, and all of the other kind at the other surface. Agreeably to this or any other imaginable view of the subject, I cannot avoid considering it inevitable that each particle must have at least two poles. It seems to me that the idea of polarity requires that there shall be in any body possessing it, two opposite poles. Hence you correctly allege that agreeably to your views it is impossible to charge a portion of matter with one electric force without the other. (See par. 1177.) But if all this be true, how can there be a "positively excited particle?"

(See par. 1616.) Must not every particle be excited negatively, if it be excited positively? Must it not have a negative, as well as a positive pole?

I cannot agree with you in the idea that consistently with the theory which ascribes the phenomena of electricity to one fluid, there can ever be an isolated existence either of the positive or negative state. Agreeably to this theory, any excited space, whether minus or plus, must have an adjoining space relatively in a different state. Between the phenomena of positive and negative excitement there will be no other distinction than that arising from the direction in which the fluid will endeavor to move. If the excited space be positive, it must strive to flow outward; if negative, it will strive to flow inward. When sufficiently intense, the direction will be shown by the greater length of the spark, when passing from a small ball to a large one. It is always longer when the small ball is positive, and the large one negative, than when their positions are reversed.*

But for any current it is no less necessary that the pressure should be on one side comparatively minus, than that on the other side, it should be comparatively plus; and this state of the forces must exist whether the current originates from a hiatus before, or from pressure behind. One current cannot differ essentially from another, however they may be produced.

In paragraph 1330, I have been struck with the following query, "What then is to separate the principle of these extremes, perfect conduction and perfect insulation, from each other; since the moment we leave the smallest degree of perfection at either extremity, we involve the element of perfection at the opposite ends?" Might not this query be made with as much reason in the case of motion and rest, between the extremes of which there is an infinity of gradations? If we are not to confound motion with rest, because in proportion as the former is retarded, it differs less from the latter; wherefore should we confound insulation with conduction, because in proportion as the one is less efficient, it becomes less remote from the other?

In any case of the intermixture of opposite qualities, may it not be said in the language which you employ "the moment we

* See my Essay on the causes of the diversity in the length of the sparks, erroneously distinguished as positive and negative, in vol. v, American Philosophical Transactions.

leave the element of perfection at one extremity, we involve the element of perfection at the opposite." Might it not be said of light and darkness, or of opaqueness and translucency; in which case to resort to your language again, it might be added "especially as we have not in nature, a case of perfection at one extremity or the other." But if there be not in nature, any two bodies of which one possesses the property of perfectly resisting the passage of electricity, while the other is endowed with the faculty of permitting its passage without any resistance; does this affect the propriety of considering the qualities of *insulation* and conduction in the abstract, as perfectly distinct, and inferring that so far as matter may be endowed with the one property, it must be wanting in the other?

Have you ever known electricity to pass through a pane of sound glass? My knowledge and experience create an impression that a coated pane is never discharged through the glass unless it be cracked or perforated. That the property by which glass resists the passage of electricity, can be confounded with that which enables a metallic wire to permit of its transfer, agreeably to Wheatstone's experiments, with a velocity greater than that of the solar rays, is to my mind inconceivable.

You infer that the residual charge of a battery arises from the partial penetration of the glass by the opposite excitements. But if glass be penetrable by electricity, why does it not pass through it without a fracture or perforation?

According to your doctrine, induction consists "in a forced state of polarization in contiguous rows of the particles of the glass" (1300); and since this is propagated from one side to the other, it must of course exist equally at all depths. Yet the partial penetration suggested by you, supposes a collateral affection of the same kind, extending only to a limited depth. Is this consistent? Is it not more reasonable to suppose that the air in the vicinity of the coating gradually relinquishes to it a portion of free electricity, conveyed into it by what you call "*convection.*" The coating being equally in contact with the air and glass, it appears to me more easy to conceive that the air might be penetrated by the excitement, than the glass.

In paragraph 1300, I observe the following statement: "*When a Leyden Jar is charged, the particles of the glass are forced into this polarized and constrained condition by the electricity of*

the charging apparatus. Discharge is the return of the particles to their natural state, from their state of tension, whenever the two electric forces are allowed to be disposed of in some other direction." As you have not previously mentioned any particular direction in which the forces are exercised during the prevalence of this constrained condition, I am at a loss as to what meaning I am to attach to the words "some other direction." The word *some*, would lead to the idea that there was an uncertainty respecting the direction in which the forces might be disposed of; whereas it appears to me that the only direction in which they can operate, must be the opposite of that by which they have been induced.

The electrified particles can only "return to their natural state" by retracing the path by which they departed from it. I would suggest that for the words "*to be disposed of in some other direction*," it would be better to substitute the following, "*to compensate each other by an adequate communication.*"

Agreeably to the explanation of the phenomenon of coated electrics afforded in the paragraph above quoted (1300), by what process can it be conceived that the opposite polarization of the surfaces can be neutralized by conduction through a metallic wire? If I understand your hypothesis correctly, the process by which the polarization of one of the vitreous surfaces in a pane produces an opposite polarization in the other, is precisely the same as that by which the electricity applied to one end of the wire extends itself to the other end.

I cannot conceive how two processes severally producing results so diametrically opposite as insulation and conduction, can be the same. By the former, a derangement of the electric equilibrium may be permanently sustained, while by the other, all derangement is counteracted with a rapidity almost infinite. But if the opposite charges are dependent upon a polarity induced in contiguous atoms of the glass, which endures so long as no communication ensues between the surfaces; by what conceivable process can a perfect conductor cause a discharge to take place, with a velocity at least as great as that of the solar light? Is it conceivable that all the lines of "contra-induction" or depolarization can concentrate themselves upon the wire from each surface so as to produce therein an intensity of polarization proportioned to the concentration; and that the opposite forces

resulting from the polarization are thus reciprocally compensated? I must confess, such a concentration of such forces or states, is to me difficult to reconcile with the conception that it is at all to be ascribed to the action of rows of *contiguous ponderable particles.*

Does not your hypothesis require that the metallic particles, at opposite ends of the wire, shall in the first instance be subjected to the same polarization as the excited particles of the glass; and that the opposite polarizations, transmitted to some intervening point, should thus be mutually destroyed, the one by the other? But if discharge involves a return to the same state in vitreous particles, the same must be true in those of the metallic wire. Wherefore then are these dissipated, when the discharge is sufficiently powerful? Their dissipation must take place either while they are in the state of being polarized, or in that of returning to their natural state. But if it happen when in the first mentioned state, the conductor must be destroyed before the opposite polarization upon the surfaces can be neutralized by its intervention. But if not dissipated in the act of being polarized, is it reasonable to suppose that the metallic particles can be sundered by returning to their *natural state* of depolarization?

Supposing that ordinary electrical induction could be satisfactorily ascribed to the reaction of ponderable particles, it cannot, it seems to me, be pretended that magnetic and electro-magnetic induction is referable to this species of reaction. It will be admitted that the Faradian currents do not for their production require intervening ponderable atoms.

From a note subjoined to page 37 of your pamphlet, it appears that "on the question of the existence of one or more imponderable fluids as the cause of electrical phenomena, it has not been your intention to decide." I should be much gratified if any of the strictures in which I have been so bold as to indulge, should contribute to influence your ultimate decision.

It appears to me that there has been an undue disposition to burden the matter, usually regarded as such, with more duties than it can perform. Although it is only with the properties of matter that we have a direct acquaintance, and the existence of matter rests upon a theoretic inference that since we perceive properties, there must be material particles to which those properties belong; yet there is no conviction which the mass of man-

kind entertain with more firmness than that of the existence of matter in that ponderable form, in which it is instinctively recognized by people of common sense. Not perceiving that this conviction can only be supported as a theoretic deduction from our perception of the properties; there is a reluctance to admit the existence of other matter, which has not in its favor the same instinctive conception, although theoretically similar reasoning would apply. But if one kind of matter be admitted to exist because we perceive properties, the existence of which cannot be otherwise explained, are we not warranted, if we notice more properties than can reasonably be assigned to one kind of matter, to assume the existence of another kind of matter?

Independently of the considerations which have heretofore led some philosophers to suppose that we are surrounded by an ocean of electric matter, which by its redundancy or deficiency is capable of producing the phenomena of mechanical electricity, it has appeared to me inconceivable that the phenomena of galvanism and electro-magnetism, latterly brought into view, can be satisfactorily explained without supposing the agency of an intervening imponderable medium by whose subserviency the inductive influence of currents or magnets is propagated. If in that wonderful reciprocal reaction between masses and particles, to which I have alluded, the polarization of condensed or accumulated portions of intervening imponderable matter, can be brought in as a link to connect the otherwise imperfect chain of causes; it would appear to me a most important instrument in lifting the curtain which at present hides from our intellectual vision, this highly important mechanism of nature.

Having devised so many ingenious experiments tending to show that the received ideas of electrical induction are inadequate to explain the phenomena without supposing a modifying influence in intervening ponderable matter, should there prove to be cases in which the results cannot be satisfactorily explained by ascribing them to ponderable particles, I hope that you may be induced to review the whole ground, in order to determine whether the part to be assigned to contiguous ponderable particles, be not secondary to that performed by the imponderable principles by which they are surrounded.

But if galvanic phenomena be due to ponderable matter, evidently that matter must be in a state of combination. To

what other cause than an intense affinity between it and the metallic particles with which it is associated, can its confinement be ascribed consistently with your estimate of the enormous quantity which exists in metals? If "a grain of water, or a grain of zinc, contain as much of the electric fluid as would supply eight hundred thousand charges of a battery containing a coated surface of fifteen hundred square inches," how intense must be the attraction by which this matter is confined? In such cases may not the material cause of electricity be considered as latent agreeably to the suggestion of Œrsted, the founder of electro-magnetism. It is in combination with matter, and only capable of producing the appropriate effects of voltaic currents when in act of transfer from combination with one atom to another; this transfer being at once an effect and a cause of chemical decomposition, as you have demonstrated.

If polarization in any form, can be conceived to admit of the requisite gradations of intensity, which the phenomena seem to demand; would it not be more reasonable to suppose that it operates by means of an imponderable fluid existing throughout all space, however devoid of other matter? May not an electric current, so called, be a progressive polarization of rows of the electric particles, the polarity being produced at one end and destroyed at the other incessantly, as I understood you to suggest in the case of contiguous ponderable atoms.

When the electric particles within different wires are polarized in the same tangential direction, the opposite poles being in proximity, there will be attraction. When the currents of polarization move oppositely, similar poles coinciding, there will be repulsion. The phenomena require that the magnetized or polarized particles should be arranged as tangents to the circumference, not as radii to the axis. Moreover, the progressive movement must be propagated in spiral lines in order to account for rotary influence.

Between a wire which is the mean of a galvanic discharge and another not making a part of a circuit, the electric matter which intervenes may, by undergoing a polarization, become the medium of producing a progressive polarization in the second wire moving in a direction opposite to that in the inducing wire; or in other words an electrical current of the species called Faradian may be generated.

By progressive polarization in a wire, may not stationary polarization, or magnetism be created; and reciprocally by magnetic polarity may not progressive polarization be excited?

Might not the difficulty, above suggested, of the incompetency of any imaginable polarization to produce all the varieties of electrical excitement which facts require for explanation, be surmounted by supposing intensity to result from an accumulation of free electric polarized particles, and quantity from a still greater accumulation of such particles, polarized in a latent state or in chemical combination?

There are it would seem many indications in favor of the idea that electric excitement may be due to a forced polarity, but in endeavoring to define the state thus designated, or to explain by means of it the diversities of electrical charges, currents and effects, I have always felt the incompetency of any hypothesis which I could imagine. How are we to explain the insensibility of a gold leaf electroscope, to a galvanized wire, or the indifference of a magnetic needle to the most intensely electrified surfaces?

Possibly the Franklinian hypothesis may be combined with that above suggested, so that an electrical current may be constituted of an imponderable fluid in a state of polarization, the two electricities being the consequence of the position of the poles, or their presentation. Positive electricity may be the result of an accumulation of electric particles, presenting poles of one kind; negative, from a like accumulation of the same matter with a presentation of the opposite poles, inducing of course an opposite polarity. The condensation of the electric matter, within ponderable matter, may vary in obedience to a property analogous to that which determines the capacity for heat, and the different influence of dialectrics upon the process of electrical induction may arise from this source of variation.

With the highest esteem, I am yours truly,

ROBERT HARE.

Art. II.—*Analysis of Sea Water as it exists in the English Channel near Brighton; by* G. Schweitzer, M. D.*

Being unaware of the existence of a correct analysis of sea-water as it exists in the British Channel, particularly with reference to the quantity of iodine and bromine it contains, I have undertaken at the request of several friends to analyze it. It is not my intention to enter into the minutiæ of the process employed, particularly as I have on a former occasion, in a small pamphlet entitled "An Analysis of the Congress Spring of Saratoga in America," published in March, 1838, given a detailed account of the mode I adopt in analyzing mineral waters. The chief object I have in view in the present communication is, to explain the method I have employed in ascertaining the proportion of iodine and bromine contained in a given quantity of sea-water. But before I enter upon the subject, it may not be out of place to show how far tests act upon iodine when in connexion with an alkali, and in a solution also containing bromides and chlorides.

From experiment I have ascertained that a minute quantity of iodine in distilled water, equal to no more than 1,500,000th part of the whole, will be distinctly indicated when mixed with starch, dilute sulphuric acid, and chlorine.

For the production of such delicate reaction, I add to every 500 grains of fluid one drop of diluted sulphuric acid, a small quantity of paste of potato starch, and two drops of a weak solution of chlorine, consisting of one part of a saturated solution diluted with 20 to 25 times its volume of distilled water. The solution gives no indication of the presence of iodine in the fluid until a sufficient time has been allowed for the separation of the starch, when a decided pink hue will be visible on the surface of the precipitate if iodine be present. It has been supposed that the substitution of pink for blue in the iodide of starch produced, arises from the presence of bromine; but this I have ascertained is not correct, as it depends entirely on the minute quantity of the precipitate acted upon by free chlorine or bromine. The following experiment will prove this fact. In order to ascertain the

* From the Lond. and Ed. Phil. Mag. for July, 1839; communicated by the Author.

delicacy of electrolytic tests of iodine, a current of electricity produced by voltaic induction was passed through a suitable glass tube, filled with 300 grains of distilled water containing $\frac{1}{3\,0\,0,0\,0\,0}$th part of its weight of iodide of potassium and a small quantity of starch, but no action was observed until a few drops of nitric acid were added, which assisting the electric current, developed, after a few brisk revolutions of the coils of the magnet, the blue color of the iodide of starch. Even a current of electricity from a single constant galvanic battery passed through the same glass tube, in which the proportion of iodide of potassium was only one millionth part of the weight of the water, indicated the presence of iodine by a pure blue speck of iodide of starch at the anode or negative extremity of the electric circuit. When iodide of potassium diluted in the same manner was properly treated with starch, sulphuric acid, and chlorine, the blue iodide of starch likewise became visible, but the smallest additional proportion of chlorine occasioned a pinkish sediment. The presence of chlorides and bromides, however, does not interfere with the action of the electric current upon traces of iodine; for a solution of salts containing, in 500 grains of water, 100 grains of chloride of sodium, 10 grains of bromide of sodium, and the five hundred thousandth part of iodide of potassium, gave a deposit of iodide of starch of a dark pinkish color. A concentrated solution of bromide of sodium, containing the millionth part of iodide of potassium, also gave by the action of the electric current a slightly pinkish deposit.

It is always necessary, when we wish to detect by means of chlorine minute quantities of an iodide, to employ the chlorine in a very diluted state, as when in excess it forms a soluble chloride of iodine which will not act on starch.

The sulphates and chlorides present in salt waters do not interfere with the delicacy of the starch test; on the contrary a concentrated solution of the chlorides will show the presence of one millionth part of iodide of potassium more distinctly than an equal volume of distilled water. This appears to arise from the iodide being a little soluble in pure water. I thought at first that a trace of an iodide might be contained in the common chloride of sodium, and thus cause a deeper tinge of blue color; but by employing a chloride of sodium prepared from pure hydrochloric acid and pure soda, I found the same degree of increased reaction.

The iodide of starch will likewise keep unchanged much longer in a solution of chlorides exposed to light and air than in pure water.

The bromides when present in large quantity interfere with the delicate reaction upon traces of iodine, but when the quantity of iodine is not too small the reaction is very distinct, as a small proportion of free bromine will, like chlorine, decompose the iodide, and produce the characteristic reaction.

After these experiments I tested fresh sea-water for iodine in the manner before described, but did not obtain the slightest indication of it. I now added one millionth part of the iodide of potassium, and the color produced by the test did not differ in the slightest degree from a solution of chlorides of the same specific gravity as sea-water, treated in the same manner, and from this I immediately inferred, that iodine, if present in sea-water, must be so in very minute quantity.

I took 73 pounds troy of sea-water, and boiled with a quantity of caustic potash, sufficient to precipitate the alkaline earth, and after filtration evaporated the fluid to four ounces. On testing a small quantity of this concentrated water, no iodine was to be detected, and it was found on adding a minute quantity of an iodide that the presence of bromides in comparatively large quantity interfered with the test. But although these results appeared to negative the presence of iodine, I felt convinced it must exist in sea-water, being present in so many sea plants and animals.

Sarphate, in his "*Commentatio de Iodio*," 1835, *Leiden* (a treatise which received the prize), states that he could detect no iodine in the sea-water near the Dutch coast. Professor Charles Daubeny likewise mentions, in his "Memoir on the occurrence of iodine and bromine in certain mineral waters of South Britain, May, 1838," that he could not detect iodine in the residuum of sea-water taken from the English Channel near Cowes, after having reduced ten gallons to less than half an ounce.

To proceed with my experiment, I freed three ounces as much as possible from the chlorides by crystallization, having first carefully neutralized the solution with hydrochloric acid. The residuum was then evaporated to dryness, ignited, and treated with anhydrous alcohol. The alcoholic fluid was afterwards evaporated, and the dry residue dissolved in a few drams of water,

when the before-mentioned test readily indicated a slight trace of iodine.

With respect to the quantity of iodine in sea-water, it is evidently very minute, 174 pounds troy not containing one grain. This is remarkable when we consider the comparatively large quantity of iodine and bromine present in sea plants and animals, hence we must conclude that these principles are concentrated by vital action.

Bromine, when present in fluids, is easily detected by chlorine, which produces a yellow color. If present in very minute quantity the fluid must first be concentrated. But when iodine is present we cannot apply this test, as bromides and iodides are both decomposed by it; and we cannot separate them, even by means of ether, as iodine is soluble in that menstruum, and also possesses greater coloring properties than bromine. From these causes this test is useless when iodine is present, and is only certain when we are previously assured of the absence of that substance.

The following process for the separation of iodine, chlorine, and bromine in fluids containing these substances in very small quantities has given me satisfactory results, as I had anticipated by previous experiment. The fluid while boiling was mixed with a sufficient proportion of caustic potash; my object in this was to decompose the earthy salts, and at the same time prevent the iodine and bromine from being dissipated by heat. The filtered fluid was then evaporated to dryness and ignited, and the resulting mass, after having been dissolved, concentrated, and neutralized with hydrochloric acid, was carefully mixed, drop by drop, with an ammoniacal solution of chloride of silver prepared by mixing one part of a saturated solution of recently precipitated chloride of silver in ammonia with one of liquid ammonia (sp. grav. 0·935) and two parts of water. If to a concentrated solution of chloride of sodium containing one thirtieth part of a bromide, we add a few drops of this ammoniacal solution of chloride of silver, the solution will remain clear; but if the most minute particle of an iodide be present, it will be rendered turbid.

To the fluid under examination I added gradually, drop by drop, the solution of ammoniacal chloride of silver, leaving time between each successive addition for the precipitate of iodide of

silver to subside. It is well when bromides are present to keep the vessel closed during the process, otherwise it is of no importance. The iodide of silver collected upon a small filter was first washed with a little diluted ammonia, and afterwards with a few drops of diluted hydrochloric acid to dissolve any earthy substance which the precipitate might contain, and ultimately with pure water.

The filter with the precipitate was dried and ignited. This experiment, repeatedly performed, yielded the most satisfactory results. It requires time, but this is more than balanced by its accuracy. Thus, for instance, I obtained by the analysis of the Congress spring of Saratoga, from 100,000 grs. of the water, 0·12164 gr. of iodide of silver, representing in 1000 grs. of the mineral water, 0·00067 gr. of iodine.

The ammoniacal fluid, separated from the iodide of silver, was carefully evaporated to expel the ammonia, whereby a small precipitate was obtained, consisting of bromide of silver, which was added to that subsequently obtained. This precipitate was formed by the solution of the chloride of silver, more of which was added than was required for the separation of the iodine. That this minute precipitate consisted of bromide of silver, was proved by heating it in a test tube with concentrated sulphuric acid, whereby it became of a delicate yellow color; whereas chloride of silver would have remained white, and iodide of silver would have obtained a brown color by parting with its iodine.

A small portion of the fluid may now be examined for bromine, and, when present, the following process may be adopted, which is the same I employed for the separation of bromine in sea-water and brine-springs, where the quantity of chlorides is comparatively very large. The concentrated solution freed from the iodine was introduced into a glass ball, having at its lower end a glass tube, and at its upper an aperture closed by a glass stopper. A concentrated aqueous solution of chlorine was added as long as any sensible yellowness was caused by its addition. The fluid was then agitated with pure ether; and after this had collected on the surface, carrying with it the bromine and chlorine, the water was allowed to flow off through the tube below, and by careful manipulation the ether could then be freed from the water, which was again treated with ether, lest any bromine

should still remain in it. The ether was directly introduced into a glass bottle, containing a solution of caustic potash fully sufficient to discolor the ether, when after evaporation and ignition it was dissolved in water, and carefully neutralized with hydrochloric acid. The concentrated solution was mixed with a few drops of an ammoniacal solution of chloride of silver prepared thus: one part of a concentrated solution of chloride of silver in ammonia, mixed with one part of ammonia and one part of water. A few drops of this mixture produced no turbidness in a solution of chloride of sodium, but indicated a very minute quantity of bromine. When no further turbidness was produced by an additional drop of this ammoniacal solution of the chloride of silver, the fluid under treatment, which was kept in an open vessel, was heated in a sand-bath until the ammonia was almost evaporated. A few drops of the test were again added, until it no longer produced turbidness, when the glass vessel was again placed in a sand-bath, until the fluid, after having been heated, gave no further indication of bromine; it was then tested again with chlorine. When the proportion of the chlorides to the bromides is not too large, scarcely a faint yellowness will be produced; if, however, it is, the bromine must again be separated by chlorine and ether, and the before-mentioned process repeated, when the last traces of bromine will be separated as bromide of silver, which is to be treated like the iodide of silver before it is weighed. In this manner I have been able to detect the smallest proportion of an iodide and bromide when accompanied by a great quantity of chlorides, and have also been enabled to separate them and to ascertain their respective quantities. Should the quantity of iodine be much larger than that of bromine, it would be requisite to evaporate a little of the ammonia; and although the addition of the ammoniacal solution of chloride of silver, employed as a test for iodine, no longer produces turbidness, it is still necessary to add another drop of the precipitating fluid, in order to ensure the separation of every trace of iodine. This is the more important, as the iodide of silver is not entirely insoluble in ammonia; and although the quantity dissolved might be exceedingly minute, still this repetition is necessary in an accurate analysis. The same precaution must be observed in the separation of bromine, as bromide of silver is to some extent soluble in ammonia, for it is obvious, that by the addition of the

ammoniacal precipitant for every portion of bromide of sodium or potassium, an equivalent of bromide of silver and chloride of sodium or potassium will be formed, and the corresponding quantity of ammonia, which kept the chloride of silver in solution, will be free and act upon the bromide of silver; but by observing the before-mentioned precaution, every error of that kind will be avoided. Should a fluid contain iodides and bromides without chlorides, and not in too small a proportion, a very good method of ascertaining their respective quantities is to precipitate them at once with nitrate of silver, and to heat the dry precipitate in an atmosphere of bromine. I have found, when iodide of silver is melted in an atmosphere of bromine, it is entirely changed into a bromide; and from the difference of the weight between the mixture of iodide and bromide of silver, and that of the whole bromide of silver, the respective quantities of iodine and bromine may be ascertained. Thus the quantity of iodine (or bromine) stands in proportion to the difference of the weight, as the atomic weight of iodine (or bromine) is to the difference of their atomic weights. Hence it would only be required for the quantity of iodine to multiply the given difference of the weight by 2.627, and for that of bromine to multiply it by 1.627. Professor H. Rose, of Berlin, applies a similar method for the separation of iodine from chlorine.—(Poggendorff's Ann. 1834, No. 37, pp. 583, 584.)

I may appear to have dwelt long upon this subject, but the importance into which brine-springs have arisen on account of their powerful components, iodine and bromine, has induced me to examine the matter closely, as it may be of consequence to the medical profession to know the exact quantity of these valuable substances.

I have briefly to add, that the quantity of chlorine in sea-water was ascertained by means of nitrate of silver, deducting from it that proportion of bromine which had been found according to the foregoing method. The quantity of sulphuric acid was found by chloride of barium, the water having previously been mixed with a little nitric acid. Another portion of the water was mixed with chloride of barium without the addition of an acid, when the difference of the weight between this and the former precipitate gave the amount of carbonate of barytes, from which the proportionate quantity of carbonic acid gas was computed;

its quantity was likewise ascertained after the distribution of the acids amongst the bases, when the surplus of the lime or of one of the other bases must have been united to carbonic acid. The quantity obtained by analysis was a little less than the last, owing to the carbonate of barytes not being entirely insoluble in water during lixiviation. Lime was separated by oxalate of ammonia, the water having been previously mixed with a proper quantity of chloride of ammonium. After the separation of lime, magnesia was precipitated by the addition of ammonia and phosphate of ammonia.

The precipitate was washed with water containing 10 per cent. of ammonia, whereby the solution of the precipitate was prevented. After the sea-water had been freed from the earthy chlorides and sulphates by hydrate of barytes and carbonate of ammonia, it was evaporated to dryness, and the residue heated to redness, and weighed. The alkaline chlorides were dissolved in water mixed with perchloride of platinum, and evaporated to dryness. The residue digested with spirits of wine containing 60 per cent. alcohol, left potassio-chloride of platinum, which was dried, weighed, and computed as chloride of potassium. The surplus of the total amount of the alkaline chlorides will give the precise quantity of the chloride of sodium.

The equivalent numbers have been computed according to the tables which H. Rose has affixed to his *Handbuch der Analytischen Chemie, Zweiter Band.*

I subjoin by way of comparison an analysis of the Mediterranean by Laurens. (*Journal de Pharmacie*, xxi, 93.)

	Sea-water of the British Channel. Grains.		Of the Mediterranean. Grains.
Water, - - - - - -	964·74372	- - -	959·26
Chloride of sodium, - -	27·05948	- - -	27·22
——— of potassium, -	0·76552	- - -	0·01
——— of magnesium, -	3·66658	- - -	6·14
Bromide of magnesium, -	0·02929		———
Sulphate of magnesia, -	2·29578	- - -	7·02
——— of lime, - -	1·40662	- - -	0·15
Carbonate of lime, - -	0·03301	Carb. of lime and magnesia,	0·20
	1000.00000		1000·00

When these analyses are compared, it will be found that the Channel water contains 9 times as much lime as the Mediterranean, but this can be accounted for, as the water flows over a bed of chalk. The Mediterranean again has twice as much magnesia and sulphuric acid.

We also find that the English Channel contains in 1000 grains water, 35·25628 grains of anhydrous ingredients; which amount corresponds very nearly to 35 grains, or 35·1 grains, obtained from several experiments, when 1000 grains were evaporated in a platina crucible, mixed with a little chloride of ammonium, to prevent as much as possible the decomposition of the earthly chlorides, and the residue carefully ignited, in order to volatilize the chloride of ammonium, where, however, a dissipation of hydrochloric acid had taken place.

Sometimes I found faint traces of oxide of iron, when the concentrated water was mixed with sulphocyanuret of potassium, particularly after boisterous weather; I found the same in respect to organic matter. The sea-water taken on a fair and calm day, when very transparent, did not yield the slightest indication of extractive matter when evaporated and ignited. A small quantity of free carbonic acid gas has been likewise found; and also extremely minute traces of chloride of ammonium were detected, when about 5 pounds of sea-water were evaporated in a water-bath to nearly half an ounce, which, mixed with caustic soda, produced fumes close to a glass rod wetted with hydrochloric acid.

Sea-water has been likewise examined for silica, alumina, strontia, manganese, phosphoric acid, and nitric acid, none of which could be detected.

The sea-water used for the occasion was taken on the 3d of June, from the surface, six miles from the shore, at high water. The weather was fair, the sea calm and extremely transparent. Its specific weight was at 60° Fahr. 1·0274. Another portion obtained by a proper apparatus from the very bottom of the sea, 10 fathoms deep, was of the same specific gravity, and likewise that taken almost close to the shore. In the month of July, after a previous rainy day, the sea-water taken four miles from the shore, had at 60° Fahr. a specific gravity of 1·0274; at a distance of 2 miles, 1·0271; and close to the shore, 1·0268. It was examined several times in August, the weather being fair and warm, when

the specific gravity amounted to 1·0274. This appeared to be the greatest weight.

When weighed in fair weather in December, it was almost 1·0271; after rain I found it to be 1·0267. These variations will of course depend entirely on the state of the weather. If the atmosphere be bright, and no heavy rain has lately fallen, the water will have, even close to the shore, the same specific weight as out at sea, but after rain it is obvious that the sea-water close to the shore will be most diluted. It is therefore indispensable that the sea-water for examination should be taken at a distance of several miles, that its specific weight should be ascertained, and that the analysis should be performed from one and the same dip.

I cannot conclude this paper without drawing the attention of medical men to the importance which the brine-springs on the Continent have lately acquired, as, for instance, the springs near Kissingen, the Adelheids-quelle, near Heilbroun, and above all, the springs of Kreugnach, which have been found highly beneficial in scrofulous diseases when internally administered, their action being dependent entirely on the chlorides, iodides, and bromides they contain. Sea-water would afford similar advantages for bathing, and when evaporated to dryness, the residue might be kept in earthen vessels, and thus be conveyed to any distance; and as its constituents are very soluble, sea-water in perfection might be procured at any place. The evaporation of sea-water should be performed with care, and the ingredients kept by chemists. One great advantage would accrue from this method, viz., that sea-water could be had of any degree of concentration which the practitioner might deem necessary. At the baths of Kreugnach, for example, extraordinary effects have been produced when from 40 to 70 quarts of the mother liquor were added to the natural salt-water of that spring, and this mixture used for bathing.

German Spa, Brighton, June, 1839.

ART. III.—*On the Halo or Fringe which surrounds all Bodies;* by Mrs. MARY GRIFFITH, of New York. (Communicated for this Journal.)

1. It is well known, that around and adhering to all surfaces there is a *halo* of demi-transparent light, seen only, however, when the object for experiment is in a certain position with regard to the eye and the light which falls on it. This halo is not dependent on any peculiarity of color or material, for it encompasses every object in nature, whether it belong to the animal, vegetable, or mineral kingdom; whether it be square or round, black or white, opaque or transparent, solid or fluid.

2. If a small or large glass globe, either solid or filled with a fluid, be held near the eye, this halo will be seen on the circumference, and will always follow the curvature of the glass whichever way it may be turned.

3. Within this halo, at irregular intervals, are certain faintly marked lines, some of which are of a dark gray and others of a whiter shade than the main color of the halo itself. These lines are always of the same density and color, but not always at the same distance apart.

4. Whatever is the size, shape, color or opacity of the object, provided it be close to the eye, and that the other eye is shut, the diameter is always the same. But while looking at it, if the closed eye opens suddenly, the diameter will contract, its illumination will be brighter, and it will expand again as soon as the disengaged eye closes. Epinus discovered the same peculiarity in the diameter of a pin-hole.

5. This halo, therefore, is attached to all surfaces, and from its uniformity and constant presence it may be fairly inferred, that it belongs to the constitution of surfaces. It is not dependent either on the refraction or inflection of light, (which is supposed to proceed from the surface on which it rests,) but light is refracted through and across this halo, and also by transparent media when it passes through them. When the halo rests on an opaque substance, whether the surface be polished or not, all the rays of light which are to convey impressions of this opacity radiate from the halo alone. It is sui generis, and is independent of the quality or property of the body to which it adheres, and although it is only

the agent through which light is effective, yet it possesses a property which light has not, for it covers the surfaces of black colored bodies, whereas light is decomposed by them. It differs likewise from the magnetic and electric fluid, for with the same property of adhesiveness which they possess, it is *visible* and is not confined to a peculiar set of objects.

6. Light renders this halo perceptible, according to the same laws which allows us to perceive all other external objects; and we are not to infer that when it is not visible it does not exist.

7. This gauzy, misty nebula, when it encompasses lenses or small apertures, has hitherto been designated by the name of fringes. The phenomena of the interference of light and of the polarization of light, arise from the peculiar properties which this halo possesses.

8. Apparently it is only perceptible on the *edge* of those bodies which are close to the eye in experiment, but in reality it surrounds and covers every part of the surface. If a card be held edgewise, close to the eye, the halo, with its lines, will be found to occupy the whole extent of plane surface. It is as diaphanous, and as permeable to light when it extends over the whole surface, as it is on a round or sharp edge.

9. The lines within this halo are not the result of any refractive or inflective process of light between the eyelashes or among the humors of the eye. That the eyelashes do not in any way contribute to their formation can be satisfactorily proved, for on looking at the halo on the edge of a *bright* object, if we draw aside, with our finger, the upper or lower lid, the shadow of the eyelashes will be seen to move regularly across the *lines* without producing the least disturbance or alteration in their position. That they do not proceed from the difference in the refractive powers of the humor can also be proved, for they are seen when the halo is represented through a lens and is thrown on a screen. But there is still another proof that the different densities of the humors do not produce them. If we hold a steel needle or any bright object horizontally and close the eyelids so as only to admit a small cone of light, and then suddenly open them, we shall still perceive the lines within the halo, although the fluid which lubricates the conjunctiva, by the contraction of the lids, has accumulated in a ridge. We shall see the lines likewise very distinctly, although the aqueous humor is very perceptible and in

constant motion. That the conjunctival fluid is pushed together so as to form a ridge, can be proved by looking at the clear sky, or a candle, through a small pin-hole in a card. On closing the lids slowly and then suddenly opening them, this ridge will be seen on the enlarged diameter of the pin-hole.

10. I have stated in section 4th, that the halo is always of the same density and diameter at a certain point of view, and that on opening the closed eye it will suddenly contract, and that the light diverging from it, will be much brighter. This contraction and expansion is not confined to those halos which adhere to edges, or to a plane surface, for all narrow slits, all small circular holes, contract and expand under similar circumstances.

11. Light falls on the halo precisely as it does on a bright brass ball. It is well known that if we breathe on the ball and pass the hand over it *horizontally*, the light from a self-luminous body will fall on it vertically. If the hand is passed over it vertically, the light will fall horizontally. This phenomenon does not arise from the presence of moisture, for the same thing occurs whether we breathe on the ball or not, although then not so perceptible. There are always inequalities even on the smoothest surface on which light would glance, but the peculiar feature of a beam of light is more clearly defined when the hand is passed over a moist surface; the ridges are then formed more distinctly.

12. The cause of the formation of the ridges must be very obvious; the hand in passing across the ball, cannot come in contact with every part of the surface; a number of elevations or ridges therefore will arise parallel to the motion of the hand, and it is across these ridges, at *right angles*, that light falls.

13. But on account of the sphericity of the ball, the beam of light will be of very narrow diameter, as it can only glance over a very circumscribed area, which area, however, is the prominent point of the ball.

14. The halo accompanies every one of the ridges following these elevations and depressions. It is always parallel to every plane or curved surface and edge, and the lines intersect each other at every angular point and around every curve or sphere without interfering.

15. If it be a *plane* surface on which we breathe, and the hand is passed over it *vertically*, the light will glance across the *whole mass* of ridges in a horizontal direction. A contrary ac-

tion will cause the beam of light to strike the mass of ridges vertically.

16. Therefore, if the object have a plane surface, the vertical lines within the halo will occupy the whole extent of vertical surface: I speak now of a square of glass, or any other object with a plane surface and standing in an erect position; the horizontal lines will occupy the whole of the horizontal surface and thus cross each other at right angles at every corner.

17. Consequently, if the *plane* surface of any object lies horizontally and the rays of light fall on it vertically, both the horizontal and vertical lines will be illuminated and the center of the plane will be the focus of illumination, the diameter of which will be greater than if the surface were spherical. But though the space of luminous contact will be of larger diameter than if the rays fell on a curve or sphere, yet the concentration will be less dense, and of course less powerful.

18. On a globular surface the action of the halo is the same, only that, from the sphericity of the globe, the lines can never cross at right angles.

19. Taking into consideration all the peculiarities and anomalies which these halos exhibit, it must lead to the conclusion, that rays of light which issue from a polished opake or transparent surface, are not immediately reflected from that surface, *but from the halo itself.* It was the opinion of many excellent philosophers that light was not reflected from the surface of a body, but that it "acted at a distance," there being several phenomena incident to light which could not be accounted for on any other hypothesis. They never detected the agency of this nebula or halo, nor will the men of science at the present day be the first to investigate the proofs of the existence of so powerful an agent.

20. I observed that the lines of the halo intersect each other; the interstices between their intersections are foci whence reflected rays issue. Rays of light diverge from these interstitial foci in all directions, so that let us stand in what position we may, with regard to the object on which the halo rests, a pencil of rays always converges to the axis of our own eye.

21. This halo, therefore, is the medium through which light acts, both near and at a distance.

22. Besides being the true reflecting medium, it has the property of acting on another halo in a specific manner, either when near or at a distance.

23. It acts upon the surface of another halo—more perceptible when they are near together—in consequence of a singular and wonderful property which it possesses. *It is lenticular in the direction of its parallelism with the edge of the body on which it rests!* If we turn a piece of glass, steel, or pasteboard, edgewise, we shall find that the lines of the halo are parallel to this edge, as edge it may be called, for it presents no more extent of surface than if it were an edge of only a line in diameter. If we turn the edge so as to let it lie horizontally, still the line will be parallel to the edge, and the interstices will preserve their lenticular property—the halo, therefore, on every edge is always lenticular in the direction of its lines.

24. If we hold a card in each hand, one near the eye and the other at a little distance from it, and then move them in a horizontal direction, so near as to shut out the light between them, the halo on the one card will appear to swell out to meet the other.

25. On a superficial view of this phenomenon we might be led to adopt the explanation given of it by Mr. Melville. In the Encyclopedia Perthensis of 1816, page 412, fig. 9, plate 257, he has given his theory, with a diagram. When we become convinced of the fact, that the interstices between the lines of every halo are constituted like lenses—being lenticular according to the parallelism of the lines with the *edge* or surface of the body on which it rests—we shall no longer be at a loss for the true theory of the swelling out of the edges of bodies to meet one another.

26. What I mean by lenticularity according to the parallelism of the halo with the edges of bodies, is this:—If the shadow of an object near the eye, is thrown on an object a few inches distant from it, and we move either of them to the right or left, the shadow of the one nearest to the eye will rest on the other and move in a direction contrary to the one we give it.

27. Therefore, if a pin is held near the eye, and another is at a little distance from it, the shadow of the former will be plainly seen on the halo of the latter, moving contrarily to the motion we give them. Here it will be observed that the *lines* in both halos, and of course the pins themselves, are parallel, and in consequence of this parallelism the shadow, though it has *one* lenticular movement—which is a reverse movement—is seen in an *erect* position. But I must observe here that this applies only to the body, or shaft of the pin, as the *head*, for reasons hereafter to be explained, does not cast its shadow on the oblong lens of a halo.

28. This elongated lens does not, like a round one, give an inverted image of the pin; *it only reverses the movements.* If a slit is cut in a card with a sharp knife, and we look through it at a candle or at the clear sky, it will be perceived that the halo is present there also, and that its lines are parallel with the slit. On moving a pin between the eye and the slit, the shadow of the pin will be seen on it, but its movement will be the reverse of the true one. In this experiment, as in the preceding one, the shadow of the body of the pin is erect, and there is no representation of the head.

29. This contrary motion of object and shadow—this lenticularity—does not belong exclusively to the overlapping of halos and to narrow slits, for I have ascertained beyond a doubt, that this nebula or halo, which exists on the edges of *all* bodies, possesses this singular power likewise. Even on the edges of our fingers, and *between* the fingers, as may be ascertained by holding up our hand before a candle, and moving a pin between the eye and the finger, the halo there seen is an elongated lens, possessing *one* lenticular movement.

30. But there is a great difference between the halos attached to the edges and surfaces of bodies, and those belonging to small *circular* apertures. The circularity, by making the rays of light from all the foci of the interstices of the halo converge to one focus, and thence radiate, reverses both the image and the movements. This circular opening—a pin-hole for instance—is then a true lens, with anterior and posterior convex surfaces, the convexity of which gives the halo its lenticular or magnifying power.

31. In whatever manner the *lines* of this lenticular halo are produced—whether owing to refraction, reflexion, or whether it be *multiplication of outline*—the fact is certain that they *do* exist, and that the halo in which they are seen is a true lens. Turn a glass globe which way we will, this halo is always parallel to the edge of the surface, and yet the globe has no *edge*, nor in fact, is there an edge to any round body, such as a pin or a pencil, sharp as it appears when close to the eye.

32. The halo is of a certain depth, and always retains its diameter and character, for the *lines* are forever parallel and the interstices lenticular. Although we are *certain* from every variety of careful experiment, that the lines cross each other in every direction, yet after the manner of rays of light, only those lines are vis-

ible that follow the *edge or surface* of the body on which the halo rests. Such is the nature of this extraordinary power, that no confusion arises from this crossing of the *lines*, for as I have frequently observed, only those are seen which are parallel to the edge whether the object on which they rest is in a vertical or horizontal position.

33. It is not the external surface alone on which the halo rests; all the inner and outer circumferences of flat bodies, and of all round or irregularly shaped apertures, are edged and lined by this diaphanous, lenticular halo. There is no opening so small, nor any so large, that is not edged with it; but its peculiar character as a perfect lens, is to be found only when the aperture is of a certain diameter. Its own diameter being limited, it becomes necessary that the aperture shall be of such a size as to allow the halo to fill it up completely, which it could not do if the aperture were too large.

34. The rays that proceed from this halo, when it lines an aperture, converge to a focus nearer or farther from this aperture according to its size, and according to its distance from the eye. It is from this focus that an image of the sun—as it is called—is seen, which image is either thrown on the floor from the hole in the window shutter of a dark room, or on the ground under trees. The same spot of bright light is projected on the wall from the slats of a window blind, at sun-rise, or sun-set—that is, if the slats are near together, or if there be a crack in one of them. When the points of contact of these slats or cracks, are close to one another, the interstices between the points become lenses, and from these focal points the small dense circles of light are seen. In cutting a slit in a card, if we press the knife on it *unequally*—making a feebler incision every half inch—on looking through the slit we shall perceive that it is composed of circular halos, instead of a long line of misty light, as is always the case when the pressure of the knife is equal, and the slit is of the same diameter throughout.

35. It has frequently been asked, why the circular spots of light under trees have that perfect regularity of outline, when the opening between the leaves are generally angular. I have already said that they are not the representatives of the *apertures*, but of the condensation of light at each focal point. It is the divergent rays from this focus that throw the shadows of lenses, such as are

seen under the trees, and such as appear on a screen or wall, in a dark room, when the light comes from a small hole in the shutter.

36. We often see under trees, openings of large size and irregular shape; on examination it will be found that they proceed from the spaces between leaves that do not hang in dense masses like those in the centre. These open, irregular spots have their inner circumference edged with a rim of smoky light, thus making manifest the influence, or rather presence of the halo, for this dull light is the representative of it. If we could trace the small dense, circular spots to their origin, at the top of the tree, we should find that they proceeded from openings as large and irregular as those which are reflected from the thinly scattered leaves nearer the outer circumference of the tree. Before the light from an irregular opening at the *top* can reach the ground, it will be intersected by portions of innumerable leaves which lie in its course, until, at last, the aperture through which it makes its final passage is so small in size as nearly to admit of a continuity of halo. Therefore, let the outline of an aperture be what it may; provided it be not of so large a diameter as to prevent the microscopic, or lenticular action of the halo; the rays of light will converge to a point, the *central* rays of which will throw on the ground or floor, a dense round mass of light, such as is called an image of the sun, and the divergent rays will throw an inverted image or shadow on the screen or wall. That some of the dense light spots are of an oblong form is owing to the obliquity of the sun's rays, or to the oblique position of the apertures with regard to the rays.

37. The halos of two objects of slender diameter will be of double density when they overlap one another. This experiment can be made by bringing them together with their edges perfectly parallel. The halos of three or four pins when placed behind one another, will be so dense, that objects beyond them will appear very indistinct, whereas through *one* halo every thing is accurately seen, through *two* dimly, through five or six, not at all.

38. Light, like all other matter, is less permeable as it becomes more dense. When it is concentrated, the feebler rays which emanate, or are reflected from objects behind it, are lost in the intensity of the mass through which they seem to pass in order to reach our eye. The concentrated density of light is the *true*

cause of our not seeing objects through it. The *continued* action of light destroys *certain combinations* which develop colors, and thus decomposes them; but light has no such annihilating power as Newton assigned to it. It is the *opacity of accumulation* which hides colored bodies from our sight; light has no power to decompose or annihilate *instanter;* on the contrary, there are certain qualities in the *black* principle which annihilates light itself.

39. There is an experiment of painting the different colors on the periphery of a wheel, and it has become a settled question in optics that these colors all blend into a white mass as soon as the wheel is in rapid motion. It is known that the duration of impression, on the organs of vision, are very limited; we cannot wonder therefore, that the feeble rays of light which are to give an impression of the colored patches on the wheel, should fail in doing so. As the rapidity of motion prevents the duration of impression of the feebler rays of colored objects, nothing remains perceptible to vision but the dense mass of light from the whole circumference of the wheel.

40. If on one side of a card—as in the beautiful experiments of Dr. Paris—we paint a head, and on the other side a body, by making the card turn rapidly, the head appears to be attached to the body. The feeble rays proceeding from that edge or line of the circumference which passes before the eye at every half revolution, are lost in the mass of light which is reflected from the colored and white portions of the card. But if the card be made to turn *very* rapidly, even the figures are hidden, because, as has been observed, the duration of impression is very limited.

41. A pin-hole at a little distance appears very small, but the aperture increases as the distance decreases. It is only when the pin-hole is close to the eye, that the true magnifying or lenticular power of the halo is recognized. It will be then perceived that it completely occupies the whole opening, and that objects which are held between the eye and the pin-hole, will all be inverted, not only inverted both as to position and movement, but also possessing a much larger outline than the objects themselves. This aperture, therefore, is a lens whose magnifying power is according to the size of the aperture and its distance from the eye.

42. On looking through the halo as it fills up the pin-hole, we shall perceive that objects beyond it are very distinctly seen, and

they appear in their true place, though not always of their true size, for this depends on the diameter of the pin-hole. There is however another very important circumstance which contributes to the erect position of external objects—*the axis of the pin-hole and our eye are strictly parallel, and all the rays which pass through the centre of this axis carry an erect impression of the object whence they emanate.*

43. I observed above that when the pin-hole is near the eye, its lenticular property is apparent. If we hold a pin between the eye and the pin-hole, the pin will be inverted. The reason of this is obvious, for according to the 23d section, the halo is lenticular in the direction of its parallelism with the edge or surface of the body on which it rests. If the pin-hole were oblong, or if the aperture were a long slit instead of a round hole, the shadow of any slender object before the eye would remain the same as to position, but be reversed as to movements. But the pin-hole being a perfect lens—for it is completely filled by the halo—any shadow cast on its surface will be reversed both in position and movement. The character of these halos never varies; they act upon one another in a sensible manner and always produce the same results.

44. Should a doubt remain as to the lenticularity of this halo on the pin-hole, we have only to observe the figure which appears on its surface. On looking steadily at the pin-hole we shall perceive that the rays of light from a candle, and which are brought to a focus on the lens of our own eye, give to the cerebral organs of vision an exact representation of all specks, flaws, spots, and movements of fluids which actually exist within the eyeball. I say cerebral organs, because a true knowledge of vision must convince us that the figure which *appears* to be in the pin-hole cannot by any possibility be painted or impressed *there*, and if not *there*, certainly not on any part of the interior of the eyeball. The very circumstance of being able to see any part of the interior of our own eye should settle the question of the *seat of vision*, and prove that the eyeball and its internal apparatus are merely for the purpose of transmitting *rays of light* and not images; that the images which are the result of these rays, are impressed on the cerebral organs with the *first* touch of light on the elastic machinery of the eye, and never come to a focus on the retina or on any other part of the interior of the eyeball. But I have pursued this branch of the subject elsewhere.

45. The lenticular character of the halo is indisputable, and every experiment will the more fully establish the fact. ***It is a true reflecting and magnifying medium, and it is entirely owing to this circumstance that a convex lens of glass possesses its magnifying power. The mere substance or material of glass is only necessary or accessory to the production of lenticular phenomena in consequence of its capability of curvature and extension.***

46. Therefore, beyond a certain point a halo cannot maintain its continuity, unless it have a solid or fluid medium on which it can expand and keep its particles in contact. Nor can its ultimate magnifying power be developed unless the material in which it rests is *convex*, for being *convex itself* it requires a continued extension of convex surface if greater magnifying power is required. An aperture which is of twice the diameter of the halo will have an open space in the center free from it. This center, therefore, is no lens, but if we put a convex glass in the aperture, the halo then has a conducting medium, and can spread itself, or rather connect itself with the halo on the glass, and thus exhibit all the powers of a lens.

47. It is the continuity of the halo throughout all the space of a small circular aperture which gives the aperture, or the convex glass within it, the character of a lens. In consequence of this continuity, lenses can be built up of many pieces, and of course there is no limit to their diameter. *Convexity being the sole requisite for a magnifying power*, it is immaterial whether the lens be of solid glass, or whether the two convex surfaces be of the thinnest glass, cemented at the circumference and the hollow space filled with a fluid. If the lens be built up of many pieces, the blocks should all run parallel with the axis of the glass and the central block should be of one piece throughout its axis, so that there may be no interruption of the rays of light through it. It is of no consequence how narrow the diameter of the block may be, for the rays which are to give impressions of external objects converge to a minute point on the apex of this block and pass in a *straight* line to the apex of the axis of our own eye: the present theory among philosophers is that the rays cross each other in the *centre* of the lens, but this is an error which will soon be corrected.

Art. IV.—*On the use of the Galvanic Battery in Blasting; by* Hamilton K. G. Morgan.

To the Editors of the Philosophical Magazine and Journal. (Lond.)

Johnstone Castle, Wexford, May 24, 1839.

Gentlemen—I beg to trespass on your time by this letter on the use of the galvanic battery, instead of the fuze in blasting.

The papers have given short descriptions of the experiments made at Chatham, but all the details were not given. I commenced my experiments on blocks of the old trees that were blown down by the late storm. I first prepared an igniting cartridge by joining two pieces of *clean* copper wire to the extremities of a steel wire taken from the scratch brush, such as is made use of by gun-makers; this steel wire is fastened to the copper wires by waxed silk; the length of steel wire to be deflagrated is one-fourth of an inch; a piece of very slight wood is spliced to both copper wires to protect the steel wire from any accident—it makes the whole strong and more convenient to be introduced into the small cartridge, which is either a quill or a small paper tube. They are filled with fine powder, and made air and water-tight, to prevent the powder from getting damp and rusting the steel wire; a second small piece of wood is then fastened to this small cartridge and the copper wires; one of the wires is bent over this piece of wood and brought up at an angle with the other upright wire. This is my exploding cartridge: it cannot be easily put out of order. The wires of the cartridge have only to be made bright before they are fastened, by twisting them round the positive and negative wires of the battery. I always place the cartridge deep in the hole made to receive the powder, in order that the pressure from the turnpeg may be taken off by the quantity of powder above it.

The wire I made use of is the common copper-bell wire. The battery is the old Wedgwood trough, with 4-inch plates, double coppers. I prevent the zinc plates from touching the copper by small pegs of wood passed through the four corners. Wooden troughs with movable divisions were tried, but not with any good result. A wooden trough with the plates in a frame of wood, with varnished paper between the copper, was tried, but the porcelain trough far surpassed them. My first experiment

was blasting single blocks; the effect was much better than when the fuze was used, in consequence of the clay being more firmly driven round the wires than it would be round the larger surface of the fuze. 2ndly, I selected two large blocks nearly in line; the first block was 43 feet from the battery; the second block 113 feet from the battery, and the blocks consequently were 70 feet from each other. On dipping the plates, the explosions took place in quick succession; the battery consisted of 30 pairs of 4-inch plates. 3rdly, I wished to try the effect of a simultaneous explosion of two blasts on a very large block firmly tied together by rivets. The positive wires of each cartridge were fastened to the positive connecting wire, and in like manner the negative wire. The effects of this simultaneous explosion were very good; the exciting liquor being weak, the connecting wires were shortened to 98 feet. 4th, To amuse some friends, I exploded some powder in one of the ponds, depth 10 feet; length of wire 210 feet; 40 pairs of plates, with old exciting liquor:—the experiment succeeded to the delight of all; a large eel was killed by the blow-up. I have no doubt but wild fowl will yet be killed by means of shells placed at low water on the banks where they feed; and by means of long connecting wires, the shells can be made to explode simultaneously among the birds.

I find that 10 pairs of 4-inch plates free from oxide and charged with the following exciting liquor—water, 6½ quarts; sulphuric acid of commerce, 4½ ounces; nitrous acid, 4¼ ounces; will ignite powder with a wire 101 feet long. 20 pairs of plates ignited powder at the distance of 353 feet. I tried to repeat this experiment, but did not succeed, though the plates were only three times immersed in the acid, and only for about two seconds each time. I tried the same battery at 268 feet, and did not succeed. The plates were then well washed, and fresh exciting liquor made: the experiment again failed; the plates were quite inactive. The next day I tried the same plates and the same exciting liquor, and succeeded at 268 feet. From this it seems impossible to say how many pairs of plates would be required to produce uniform effects at long distances. I suspect that the zinc plates do not act equally in producing the electricity, which causes this variation.

I should have liked very much to have tried the conducting properties of different sized wires, but had not an opportunity of getting them here.

Not having seen any notice of this novel and safe method of blasting in your excellent journal, induced me to send you these few remarks.

I believe I am the first in Ireland that applied the galvanic battery instead of the fuze in blasting.

ART. V.—*On the Tails of Comets;* by WILLIAM MITCHELL, of Nantucket, Mass.

THERE is perhaps no department of astronomical science, connected with the solar system, of a nature more interesting than that of Comets, and certainly no one which has so nearly defied the researches and the reasonings of the astronomer. Aside from these bodies, if such they may be called, the greater and the lesser lights have been subjected to rigorous weight and measure, and the solar system is emphatically the beaten way of the astronomer. Comets however have presented difficulties so insuperable, that in latter times the subject seems to have been nearly abandoned in despair; and armed as the present age may be against the horrors of superstition, a cometary appearance as imposing as that of 1680, or even of the less threatening aspect of that of 1744, would create no small degree of uneasiness in some hearts of the stoutest mould. When Dr. Olbers announced that a portion of the earth's orbit would be involved in the nebulous atmosphere of Biela's comet in 1832, one half at least of the civilized world quaked with fear. Notwithstanding the alluring promise held out to the modern student by the glories of siderial astronomy, nothing can justify a neglect of phenomena which, by a close investigation, might result in contributing so much to the tranquillity of the world. Impressed forcibly in my youth by the beautiful appearance of the comet of 1807, and, at a riper age, with those of 1811, 1819, 1825, and 1835, visible to the naked eye, and with others, seen at various periods by telescopic aid, I have been led frequently to reflect on the probable nature and physical properties of these erratic objects, and especially on that distinguishing appendage which by common consent is denominated the *tail.* In looking over the history of comets, and noting the explanation of the trains (with which they are for the

most part attended) as given by many distinguished astronomers, at periods very remote from each other, I am constrained to acknowledge, high as the authority unquestionably is, that no one has afforded to my mind the slightest satisfaction. Notwithstanding the great number of writers on this subject and the diversity of opinions that have been promulgated, there appears to have been only two prevailing theories. The more ancient of these supposed the tails to be formed by the lighter parts being thrown off by the resistance of the ether through which the comet passed. The modern and the more generally prevailing theory is, that these particles are driven off by the impulsive force of the sun's rays. In each of these theories, the tails are supposed to consist of *matter*. With regard to the former theory, the simple fact that the tail precedes the comet in its course through a portion of its elliptical journey, is a sufficient refutation; and to afford weight or plausibility to the latter, it is necessary to assume that the sun "blows heat and cold with the same breath"—in other words, that it attracts and repels with the same *modus operandi*. If we have no evidence of a repulsive force in the sun, to say nothing of a force sufficient to repel the lighter particles of these bodies to a distance from the head of the comet, equal to and sometimes exceeding a hundred millions of miles, this theory, to say the least of it, is labored and unsatisfactory. The length of these trains is far from being exaggerated. Referring to my minutes of the late return of Halley's comet, I find that, at one period, the tail, by direct vision, subtended an angle of twenty degrees, and on some occasions, by oblique vision, more than forty degrees. The tail of the comet of 1689 is said to exceed sixty eight degrees, and that of the comet of 1680, ninety degrees. Making a proper allowance for the faintness of the extremity of the tail, and the obstruction of the view by the atmosphere of the earth, it is by no means unsafe to conclude that many of them extend some hundreds of millions of miles from the nucleus of the comet.

In view then of the last mentioned theory, it is by no means a matter of surprise that Newton, and with him La Place and Sir J. Herschel, should entertain the opinion that the more remote particles could never be recalled by the gravitation of the nucleus, and that portions of the tails were at each revolution scattered in space, and hence that comets were continually wasting.

Arago, in speaking of the then anticipated return of Halley's comet in 1835, makes the following remark: "It appears probable that in describing their immense orbits, comets at each revolution, dissipate in space all the matter which when they are near the perihelion, is detached from the envelop forming the tail; it is therefore very possible that in time some of them may be entirely dissipated." But these views were not confirmed by the appearance of Halley's comet in 1835, and Arago has with a very becoming candor promptly acknowledged this fact. "If the reader," says he, "will take the trouble to compare what I record of the comet of 1835 with the circumstances of its former apparition, he certainly will not find in this collection of phenomena the proof that Halley's comet is gradually diminishing. I will even say that if, in a matter so delicate, observations made at very different periods of the year, will authorize any positive deduction, that which would most distinctly result from the two passages of 1759 and 1835, would be that the comet had increased in size during that interval. I ought to seize with more eagerness, this occasion to combat an error extensively accredited, (a belief in the constant wasting away of comets,) because I believe I have somewhat contributed to its dissemination."

The truth is, as I apprehend, that the data on which this conjecture was based, are probably false, and the tails of comets, if the subject is properly investigated, will not be found to consist of matter at all that has the least connection with the comet, but *formed by the sun's rays slightly refracted by the nucleus in traversing the envelop of the comet, and uniting in an infinite number of points beyond it, throwing a stronger than ordinary light on the ethereal medium, near to or more remote from the comet, as the ray from its relative position and direction is more or less refracted.*

It is not important to the truth of this hypothesis whether the nucleus be a solid mass or not, so that it be more dense than the surrounding nebulosity, nor yet that the tail be projected in an exact line with the radius vector of the sun and comet, so that it be nearly so. It is however important to its truth that an ethereal medium should exist, otherwise the reflection of these points of light would be impossible; also that the comet should *assume* the tail as it approaches the sun, and that it should progressively increase in length and brilliancy, the light of the sun increasing in

the proportion of the square of the diminution of distance,—again that the tail should have a cylindrical and hollow appearance, the rays of light being at least partially obstructed by the nucleus; moreover, that the tail should be curved, by the necessary effect of aberration. I apprehend it will be acknowledged that the weight of testimony is decidedly favorable to the fact that the nuclei of comets, though they generally resemble planets in form and brilliancy, may not be solid or opaque, inasmuch as some are unquestionably transparent, and the quantity of matter in all is exceedingly inconsiderable.

Professor Struve saw a star of the eleventh magnitude through the Encke comet; Sir William Herschel noticed one of the sixth magnitude through the centre of the comet of 1795; and his illustrious son, in a memoir communicated to the Royal Astronomical Society, mentions that he saw a cluster of stars of the sixteenth magnitude very near the centre of Biela's comet. Notwithstanding this tenuity, an increased density may always be noticed toward the centre of the head, except in a few small comets unaccompanied with trains.

Astronomers of all ages seem to have been inclined to a belief in an ethereal medium, and the present one has afforded a conclusive evidence of its existence, in its effect upon the duration of the revolution of the Encke comet. Professor Encke in a dissertation on this subject, after giving the minutiæ of his observations, very modestly remarks—"If I may be permitted to express my opinion on a subject which for twelve years has incessantly occupied me, in treating which I have avoided no method, however circuitous, no kind of verification, in order to reach the truth so far as it lay in my power; I can not consider it otherwise than completely established, that an extraordinary connection is necessary for Pon's* comet, and equally certain that the principal part of it consists in an increase of the mean motion proportionate to the time." Professor Airy, in an appendix to a translation of Encke's memoir, adds—"I can not but express my belief that the principal point of the theory, namely, an effect exactly similar to that which a resisting medium would produce, is perfectly established by the reasoning of Professor Encke." Arago, in speaking of the discrepancy between the result of calculation and

* Called by others Encke's comet.

observation on the period of the Encke comet, states unhesitatingly that the cause "can be nothing but the resistance of the ether." And Dr. Bowditch, distinguished as he was for cautiousness, fully recognized the effect of an ethereal medium, in the translation of the *Mécanique Céleste.* The fact however that Halley's comet at its late return reached its perihelion *later* rather than *earlier* than the calculated time, independent of an allowance for a resisting medium, seems to have created some doubts in reference to the doctrine of resistance; but of the three comets whose periods are certainly known, those of Biela and Encke only can be relied on as indicating resistance, inasmuch as that of Halley has its aphelion in a region beyond the scan of human power, and the influence of planetary bodies which may exist there, is now and will perhaps forever remain unknown to us. These facts then, and the concurring opinions of the high authority above quoted, render it nearly unquestionable that there is diffused through the celestial regions an ethereal and exceedingly elastic medium; nor would it be unreasonable to suppose that this very medium constitutes the solar atmosphere, of which the zodiacal light may be a denser region.

When an opportunity is offered to observe a comet remote from the sun, it is generally found to be unaccompanied with a tail; but as it approaches, the tail begins to appear, and its length and brilliancy increase, till it reaches the perihelion of its orbit, and by an illusion, sometimes beyond this point. Although there is some degree of diversity in the form of the tails of different comets, yet they generally consist of two streams of light, not absolutely distinct from each other. In other words, the borders of the tail are brightest, plainly indicating a hollowness, the line of vision necessarily meeting with a greater number of luminous points on the edges than through the middle. Can any explanation of this hollowness be given, more simple and philosophical, than that the *rays of the sun's light* are more obstructed by the denser than the rarer portions of the comet?

That there is, in these tails, which acquire a considerable length, a slight curve, concave to that portion of the orbit which the comet has left, there is ample testimony. Now as light is progressive, a portion of time must elapse while the rays of light are passing from the head of the comet to their point of union, and during this period the comet moves onward in its course, and the result necessarily is a gentle or slight curve in the tail, the effect being

greater or less in proportion as the union of rays is more or less distant from the comet. It is manifest that if a ray of light could be traced during its entire course from the sun to a planet, it would present a similar phenomenon, equal in degree if the motion of the planet were swift as that of a comet. The comets of Biela and Encke have no tails, nor is there, strictly speaking, a nucleus in either. That of Encke, during the long period in 1828, when its position was so favorable to observation, had the appearance of a mere film of vapor, nearly circular but not well defined, and no central, stellar point could be detected with the telescopic power which I employed on that occasion. In fact, all the phenomena of the tails of comets appear to be so well explained by this theory that I can not doubt its truth, although nothing like demonstration accompanies it. There are indeed optical difficulties which I have been unable to overcome: no one however which may not be fairly attributed to our ignorance of the particular physical constitution of these bodies. It is no small confirmation of the truth of this explanation of the tails of comets, that there is not the slightest evidence, worthy of confidence, that the earth which we inhabit has ever been sensibly affected by a visitation from these enormous appendages, while the chance of collision between the earth and the *nucleus* of a comet, properly so called, is exceedingly small; yet when we reflect upon the number of comets belonging to our system, the hundreds that range within the earth's orbit, that their paths have every possible inclination to the ecliptic, that these immensely extended trains, projected in a direction *from* the sun, describe an inconceivable sweep when they are encompassing the sun in the region of their perihelion;—I say in view of these circumstances, it is difficult to avoid the conjecture, nay, it is exceedingly probable that these appendages, in very many instances, have brushed across the surface of our planet, harmlessly and unperceived.

I submit this theory (if indeed it is entitled to that name) to the consideration of the scientific, having no point to gain, no wish to gratify, but the promotion of science and the progress of truth, and if insuperable objections to it are raised, and my reasoning should prove fallacious, there will be at least one valuable result, that of showing what the tails of comets are not; moreover, it may be the humble means of exciting further inquiry on this interesting topic.

Nantucket, 10th mo., 1st, 1839.

Art. VI.—*A Gissi or Kissi Vocabulary;* by Prof. J. W. Gibbs.

The following list of Gis-si words and phrases is taken from the mouth of John Ferry, an African, who was born at Slan-go-lo, a town of Yom-bu, in the Gis-si country, and is now resident in New-York. He was brought from his native country about the year 1821 or 1822, at the age of 11 or 12, but has often conversed with Gis-si people since that period.

One	pe-le
Two	mi-ûng
Three	nga
Four	hi-o-lu
Five	ngwai-nu
Six	gnom-pum
Seven	gnom-me-u
Eight	gnom-ma
Nine	gnom-ma-hi-ol
Ten	to
Twenty	bi-din
Thirty	bil-li-a
Forty	bil-li-hi-ol
One hundred	kem-me pe-le
Head	bul-leng
Hair	yin-de
Ear	ni-leng
Eye	hol-leng
Nose	mi-lin-do
Mouth	sôn-do
Lip	tshaw-tshawn
Tooth	tshin-dong
Tongue	di-e-mo-leng
Hand	ba
Foot	beng-gu
Sun	pa-ra-leng
Moon	pan-gwi
Heaven	ha-la
Fire	in-ding
Water	men-dang
God	ha-la ma-la-ka, i.e. heaven king.
Man	la-gna-gnaw
Woman	won-na-lan-no / wain-du
Child	tu-a-le-bo
Father	fo-gna
Mother	ka-la / ndo-a
King	su-lo
Slave	kel-ling
Name	di-u-lang
People	won-da
Village	son-da-kol-lo
Town	t-he
Country	ka-leng
Good	ken-daw
Bad	wawn-du
Big	o-ben-du
Little	pom-bo
Old	yu
Young	pom-bo
Old	pan-du
New	son-ne
White	hûm-bu
Black	ti-gni
Strong	ken-du
Sick	na
I	ya
Thou	nom
He	ûn-du
She	ûn-du
We	na
Ye	in-da
They	in-da
My hand	ba-nu
My foot	beng-gu-nu
Thy foot	beng-gu-nom-do
His foot	beng-gu-ndaw
Our foot	beng-gu-na
Your foot	beng-gu-in-da
Their foot	beng-gu-in-da
My father	fo-gna-nu
Thy father	fo-gna-nom-do
His father	fo-gna-ndaw
My mother	ka-la-nu
Thy mother	ka-la-nom-do
His mother	ka-la-ndaw

Her mother	ka-la-ndaw
Our mother	ka-la-na
Your mother	ka-la-in-da
Their mother	ka-la-in-da
I eat	ya i-di-e
Thou eatest	nom a-di-e
He eats	ûn-du a-di-e
We eat	na i-di-e
Ye eat	in-da a-di-e
They eat	in-da a-di-e
A king	su-lo
Kings	su-la
Close by the king	su-lo-li-ko
A man	la-gna-gnaw
Men	lang-ba
One man	la-gna-gnaw pe-le
Two men	lang-ba gnûng
Three men	lang-ba a
Four men	lang-ba hi-ol
Five men	lang-ba ngwai-nu
A good man	la-gna-gnaw ken-daw
A bad man	la-gna-gnaw wawn-du
A white man	la-gna-gnaw hûm-bu
A black man	la-gna-gnaw ti-gni
God loves men	ha-la-ma-la-ka tshu-le lang-ba
Men love God	lang-ba tshu-le ha-la-ma-la-ka
Give to me	yon-ge-a

The Kissi numerals, according to Dr. Prichard, are, 1. pi-li, 2. miu, 3. nga, 4. i-ôl, 5. ngue-nu, 6. ngom-pum, 7. ngom-mi-u, 8. ngom-mag, 9. ngue-nu-iol, 10. to.—*Researches into the Physical History of Mankind.* Lond. 1837. Vol. II. p. 99.

Dr. Prichard also says: "The Kissi are a people of whom we know nothing, except that they inhabit the mountainous country about the sources of the Niger, to the southward of Sulimana and Sangara."—*Researches*, Vol. II. p. 75.

I add from my informant.

The Gis-si country is bounded on the south by the Men-di country and on the west by Kon-no.

The Gis-si people constitute three kingdoms; one, the capital of which is close to Kon-no; the second, the capital of which is Kwin-de-hu; the third, the capital of which is Yen-gi-ma.

The principal towns in the Gis-si country are Te-i-du, Dwa-va, Slan-go-lo, Yen-gi-ma, Kwan-go, Dzhûm-ba-u, Bom-gba-du or Zon-gi-a-ma, Kom-man-du, Di-gwi-na, Ban-do-ning, Ton-gi, Sai-i-du, Du-gau-no, Kwin-de-hu, Kon-dzhu, Dzho-po-a-hu, Tshe-son-ne, i. e. new town, Dzham-ba-u, Ta-ku-lo, Su-a-du, Yaw-baw-du, Den-go-ben-gu, De-hu-ma, etc.

The principal rivers are (1.) Ma-ku-na, which flows by Slan-go-lo and Dzham-ba-u in the Gis-si country, by Kwan-go and Yen-gi-ma, now in Gis-si, formerly in the Men-di country, and thence into the Men-di country; (2.) Me-li, which flows by Di-gwi-na and Yaw-baw-du, and thence to the Kon-no country; and (3.) Ma-gna.

Art. VII.—*A Vai or Vey Vocabulary;* by the Same.

The following list of Vai words and phrases is taken from the mouth of John Ferry, who is mentioned in the preceding article, and who lived about one year in the Vai country.

One	don-do
Two	fil-la
Three	sa-kwa
Four	na-ni
Five	sô-lu
Six	sun-don-do
Seven	sun-fil-la
Eight	sun-sa-kwa
Nine	sun-na-ni
Ten	tân
Twenty	fil-la-ban-di
Thirty	sa-kwa-ban-di
Forty	na-ni-ban-di
One hundred	hun-dred don-do
Head	ku-gne
Mouth	da
Hand	bu-lu
Foot	king
Sun	te-le
Moon	ka-lu-i
Leaf	dzham-ba
Fire	ta
Water	dzhi
God	ga-lum-ba
Man	kai
Woman	mu-shu
Child	di-gne
Little child	ding-di-gne
Father	fa
Mother	ba
King	man-dzha
Slave	dzhong
Pain	dûng
Name	to
People	moi-nu
House	ki-gne
Village	wa-e-law
Town	zan-dzha
Country	bul-le-lu
Morning	za-ma
Night	dzhe-lu-ma
Green wood	kong-e
Dry wood	soi
Good	bel-le / a-gni
Bad	a-ma-gni
Large	ki-li-ma
New	nam-ma
White	be-ma
Black	vi-ma
Sick	ki-la
All	bi
I eat	na dong
I drink	na mi
Open	ka
Shut	ma
Yes	e-he
No	bul-le
I	nga
Myself	nga-won-ga
Thou	i
Thyself	i-won-ga
He, she	a
We	mo-a
You	i-nu
They	a-nu
My king	na man-dzha
Thy king	i man-dzha
His king	a man-dzha
Her king	a man-dzha
Our king	mo-a man-dzha
Your king	i-nu-man-dzha
Their king	a-nu man-dzha
My house	na ki-gne
Thy house	i ki-gne
My father	ûm fa
Thy father	i fa
His father	a fa
Our father	mo-a fa
My mother	ûm ba
Thy mother	i ba
His mother	a ba
Our mother	mo-a ba
One king	man-dzha Jon-do
Two kings	man-dzha fil-la
Three kings	man-dzha sa-kwa

One man	kai don-do
Two men	ka-ye fil-la
Three men	ka-ye sa-kwa
Hands	bu-le-nu
Feet	king-e-nu
Leaves	dzham-ba-e-nu
Men	ka-ye-nu
Women	mu-she-nu
Children	di-gne-nu
Kings	man-dzha-e-nu
Slaves	dzhong-e-nu
Names	to-e-nu
I eat	na dong
Thou eatest	ya dong
He eats	a dong
She eats	a dong
We eat	mo-a dong
They eat	a-nu-a dong
People eat	moi-nu-a dong
A good man	kai bel-le / kai a-gni
Good men	ka-ye-nu a-gni
A bad man	kai a-ma-gni / kai yam-ma
A white man	kai be-ma
A black man	kai vi-ma
God loves men	ga-lum-ba-a ka-ye di-a
Men love God	ka-ye-a ga-lum-ba di-a
What is your name?	i to a-le
Give to me	in-ko
A Vai man	Vai mo
Vai men	Vai moi-nu
Mendi people	Hu-lo moi-nu
In the house	ki-gne-lo
In my house	na ki-gne-lo
In thy house	i ki-gne-lo

According to Ashmun, the Fey or Vey people extend from the Gallinas river to Grand Cape Mount, a distance of fifty miles along the coast, and from twenty-five to thirty miles into the interior. *Afr. Repos. III.* 259.

According to my informant, the Vai country constitutes two kingdoms, of which Ma-nu and Gen-du-ma are the capitals.

The principal towns in the Vai country are, Manu, not far from the sea, the residence of king Fu-li-ka-va; Gen-du-ma, three or four miles from a river, and nine or ten from the sea, the residence of king Sha-ka; Zalu, about twenty miles from the sea, subject to king Fu-li-ka-va; Dzhu-ling, near the sea, subject to king Sha-ka; Ho-wil-li, twenty or thirty miles from the sea, subject to king Fu-li-ka-va; Dam-ba-ru, close to Zalu, subject to king Fu-li-ka-va.

Art. VIII.—*A Mendi Vocabulary;* by the Same.

The following list of Mendi words and phrases is taken from the mouths of James Covey and Charles Pratt, native Africans.

The former was born at Go-raun, by the river Mo-a, in the Mendi country; brought from his native country by Africans to Bullom, and sold there to the Spaniards; recaptured by the English; taught to read and write English in the English schools at Sierra Leone; and is now a sailor on board the British brig of war Buzzard.

The latter was born at Sierra Leone of Men-di parents, and is now a cook on board the above mentioned vessel.

One	e-ta
Two	fe-le
Three	sau-wa
Four	na-ni
Five	do-lu or lo-lu
Six	we-ta
Seven	waw-fe--la
Eight	wai-ya-gba
Nine	ta-u
Ten	pu
Twenty	pu fe-le
Thirty	pu sau-wa
Forty	pu na-ni
All	gbe-le
Half	mo-ni
Head	ngwi
Forehead	la-wai or ta-wai
Hair	yûm-boi
Hair of the head	ngwi yûm-boi
Ear	gu-li
Eye	ngau-ma
Eyebrow	ngau-ma bi-ka
Nose	ho-gbai
Mouth	nda
Lip	nda-gu-lu
Tooth	gong-gol-lu
Tongue	ne
Hand	lo-kwi
Arm	lo-kwi
Foot	gaw-we
Leg	gaw-we
Sun	fu-li
Sunrise	fu-li gwa
Sunset	fu-li gu-la
Morning	ngin-da
Evening	bo-ko
Night	gbin-di
Moon	nga-li
Star	tûm-be-le-gai
Wind	fe-fe
Fire	ngom-gbi
Water	ndzhe
Rain	dzhe-lo-wa
Rain water	ngwa-ye
River	ti
Open land	dzho-po-a
Green wood	ngu-li
Dry wood	kaw-wi
Grass	dzha-te
Leaf	tu-fe
Island	ting -hu
Small island	ti-wu-li-hûng
Bird	ngwaw-ni
Fish	gne
Baboon	ngo-lu
Cat	ma-gna-ri
Cow	ni-ke
Dog	ngil-le
Elephant	he-li
Goat	ndzhi
Hedgehog	pi-wi
Hog	dôn-de
Horse	su-i
Leopard	kaw-li
Male leopard	kaw-li hin-ne
Female leopard	kaw-li ha-le
Lion	su-bu
Monkey	kwa-le
Male monkey	kwa hin-ne
Female monkey	kwa ha-le
Mouse	gni-ne
Sheep	ba-le
English bird (duck)	pu-ngwaw-ni
God	ngil-li ge-waw
Great God	ge-waw wa
Man	ta-moi
Great man	ta-mo wa
Young man	ta-mo wu-lu
Woman	gna-pu
Young woman	gna-ha-lu-po
Father	ke
Mother	ndzhi
Child	do-le
Brother	ndig-ge hin-du
Sister	ndig-ge ya-ha-lu
Friend	ba-la
King	ma-hai
Governor	ma-hai
Slave	nduo
Man Slave	nduo hin-ne

Woman Slave	nduo gna-ha
Name	nda
Book	kol-le or kor-re
Mat	nga-le
Bed	bu-kaw
House	pe-le
Tobacco	tá-we
Pipe	ta-wé
Tobacco snuff	ta-wu-ke
Knife	bo-e
Ship	den-de
Englishman	pu-lu moi
People	nûn-ga
Town	ta-wa-hu / te-gnu
Village	fu-le-nu / ba-ba-hu
Country	ndau-e-re
Good	yan-din-go
Bad	e-yan-din-ne / yam-mûng-gwaw
Great	gaw-lawng-gaw / wa
Small	ku-lo-paw-te / ku-lon-go
Strong	ba-yan-go
Weak	ha-lan-go
Old	go-wan-go
New	ni-nan-go
Aged	go-wan-go
Young	ku-lon-go
White	ko-lin-go
Black	te-yin-go / le-yin-go
Sick	ma-wu-la
English	Pu-lu
Born	ndi
True	taw-gna-li
False	nde-mi-la
Beautiful	yan-din-go
Ugly	yam-mûng-gwaw
Male	hin-ne
Female	ha-le
Eat	me
Drink	gbaw-li
Sleep	yi
Stand	lo
Walk	dzhi-a
Come	wa
Go	di
Open	ndau
Shut	baw-lu
And	ke
If	na
Yes	e-he / um-hu
No	bi-le
Who?	yi-le
What?	be-gbe
Where?	min-du
When?	mi-gbi
This	dzhi
Here	bin-du
Now	san-gi
That	na
There	mi-lan-du
Then	san-gi
I	gna
Thou	bi-a
He	ta
She	ta
We	mo-a
Ye	wa
They	ti-a
I myself	gna be-kpe
Thou thyself	bi-a bi be-kpe
He himself	ta-ngi be-kpe
We ourselves	mo-a mu be-kpe
Ye yourselves	wa wu be-kpe
They themselves	ti-a ti be-kpe
Thy head	bi-gwi
Thy forehead	bi-la-wai or bi-ta-wai
Thy ear	bi-wu-li
My eye	gna-gau-ma
Thy eye	bi-gau-ma
His eye	ta-ngi-gau-ma
Her eye	ta-ngi-gau-ma
Thy eyebrow	bi-gau-ma-bi-ka
Thy mouth	bi-da
Thy lip	bi-da-gu-lu
Thy hand	bi-lo-kwi
Thy arm	bi-lo-kwi
Thy foot	bi-gaw-we
Thy back	bi-wu-ma
My father	gna-ke
Thy father	bi-ke
His father	ta-ngi-ke or ngi-ke

Her father	ta-ngi-ke or ngi-ke
Our father	mo-ke
Your father	wu-ke
Their father	ti-ke
My mother	gna-ndzhi
Thy mother	bi-ndzhi
His mother	ta-ngi-ndzhi
Her mother	ta-ngi-ndzhi
Our mother	mo-ndzhi
My king	gna-ma-hai
Thy king	bi-ma-hai
His king	ngi-ma-hai
Her king	ngi-ma-hai
Our king	mo-ma-hai
Your king	wu-ma-hai
Their king	ti-ma-hai
My book	gna-kol-le
Thy book	bi-gol-le
His book	ta-ngi-gol-le
My house	gna-pe-le
Thy house	bi-we-le
His house	ta-ngi-wele
Her house	ta-ngi-we-le
Our house	mo-we-le
My knife	gna-bo-e
Thy knife	bi-bo-e
His knife	ta-ngi-bo-e
Her knife	ta-ngi-bo-e
Our knife	mo-bo-e
Your knife	wu-bo-e
Their knife	ti-bo-e
This book	kol-le dzhi
These books	kol-le dzhi
That book	kol-le na
Those books	kol-le na
What book?	kol-le gbe
What books?	kol-le gbe
Any book	kol-le gbe-le
One ship	den-de yi-ra

One man	ta-mo yi-ra
Two men	ta-moi fe-le
Three men	ta-moi sau-wa
All men	ta-moi gbe-le
A good man	ta-mo yan-din-go
A bad man	ta-mo e-yan-din-ne
A white man	ta-mo ko-lin-go
A black man	ta-mo te-yin-go ta-mo le-yin-go
I eat	gna gi-me
Thou eatest	bi-a bi-me
He eats	ta e-me
We eat	mo-a mu-me
Ye eat	wa wu-me
They eat	ti-a ti-me
I sleep	gna gi-yi
Thou sleepest	bi-a bi-yi
He sleeps	ta i-yi
She sleeps	ta i-yi
We sleep	mo-a mu-yi
Ye sleep	wa wu-yi
They sleep	ti-a ti-yi
I make	gna gi-pi-li
Thou makest	bi-a bi-pi-li
He makes	ta e-pi-li
We make	mo-a mu-pi-li
Ye make	wa wu-pi-li
They make	ti-a ti-pi-li
Thou drinkest	bi-a bi-gbaw-li
Thou standest	bi-a bi-lo
Thou walkest	bi-a bi-dzhi-a
Thou comest	bi-a bi-wa
I have eaten	gna gi-we-la a-me-la
Thou hast eaten	bia bi-we-la a-me-la
He has eaten	ta e-we-la a-me-la
We have eaten	mo-a mu-we-la a-me-la
Ye have eaten	wa wu-we-la a-me-la
They have eaten	ti-a ti-we-la a-me-la

This book is mine	kol-le dzhi gna wo mi-na
This book is thine	kol-le dzhi bi wo mi-na
This book is his	kol-le dzhi gi wo mi-na
This book is ours	kol-le dzhi mu wo mi-na
This book is yours	kol-le dzhi wu wo mi-na
This book is theirs	kol-le dzhi ti wo mi-na
I am your friend	gna ba-la bi-a gna ba-la law a bi-a
I am his friend	gna ba-la law a gi-e

I go to Africa	gna gi-ya Men-di
I come from Africa	gna gi-hi-ya Men-di
God sees me	ge-waw e gna lo-a
I see God	gna gi ge-waw lo-a
God sees good men	ge-waw e ta-moi yan-din-go lo-a
God sees bad men	ge-waw e ta-moi e-yan-din-ne lo-a ge-waw e ta-moi yam-mûng lo-a
Shuma knows Kimbo	Shu-ma Kim-bo gau-law
Shuma strikes Kimbo	Shu-ma Kim-bo de-wi-a
Kimbo strikes Shuma	Kim-bo Shu-ma de-wi-a
What do you call this in Mendi?	ba-ye dzhi lo-li Men-di yi-a hung?
Did I say it right?	gna gin-de yan-din-go?
I will not	gna gi-ru-ma-ni
Thank you	bi si-a
Have mercy on me	gi-la-ba-rung
Good bye	mu-ngen-da-he.

Some of the principal towns in the Men-di country, according to Covey and Pratt, are Dzha-e-ve-fu-lu, Go-raun or Go-la-hûng, Bai-ma, Se-bi-ma, Si-ma-bu, Gna-ya-hung, Gong-a-bu, Bom-ba-li, Fo-la, Fu-la-wa, Ben-de-bu, and Ben-der-ri.

The principal rivers are (1.) Mo-a, which runs into the Vai country; (2.) Sewa, which runs into the Bullom country; (3.) Ma-wu-a, which comes from Gissi, where it is called Ma-ku-na, and joins the Mo-a; (4.) Ma-le, which flows by Dzho-po-a, and joins the Mo-a; (5.) Ta-yem-ma, which joins the Sewa; (6.) Ke-ya, which comes from Gola, and joins the Ma-wu-a.

Prayer composed for the use of the Mendi prisoners at New Haven, by their teachers, and translated into Mendi, by James Covey.

O Ge-waw wa, bi-a-bi yan-din-go; bi-a-bi ha-ni gbe-le ba-te-ni; bi-a-bi fu-li ba-te-ni; bi-a-bi nga-li ba-te-ni; bi-a-bi tûm-bi-le-gai ba-te-ni; bi-a-bi ngi-yi ba-te-ni; ke ndzha wa; bi-a-bi dzha-te ba-te-ni, ke ngu-li, ke gnwaw-ni, ke nwu-a, ke nûn-ga wu-lo-a.

O Ge-waw, bi-a-bi hin-da gbe-le; bi-a-bi ta-moi si-na ti-gbe-le lo-a; bi-a-bi gna lo-a; bi-a-bi gna di lo-a; bi-a-bi gna lo-a, ki-a fu-li a-gu-a; bi-a-bi gna lo-a gbin-di; bi-a-bi gi-li-la hin-de gbi gna-ga ka-la.

O Ge-waw, bi-a-bi gna gaw ko-la, gna-gi si-a-gwa bi-ma; bi gna gaw me-he gi me ke gi gbaw-li, gi si-a-gwa bi-ma. Gna di ei ha, gna di a-lo-law ku-na-faw. Gna di ba-te yan-din-go. Gna-gi bi maw-li, bi gna-ma hum-gbi. Gna-gi bi maw-li, bi gna daw-wung yan-din-go. Gna-gi hin-da yam-mo wi-li-a. Ma-nu gna-ma. Gi bi-ma ni-ni-a. Ki-a nga ha, bi gna di we, bi di-la hin-da bi-gbe; Ge-waw wa ndui wa. Amen.

ART. IX.—*Vegetable Organography and Physiology, or the Formation and Vital Functions of Plants;** by HORACE GREEN, M. D., of New York.

THE study of the structure of vegetables and of the phenomena of vegetable life—a study embracing a wide and an interesting field for observation—has been very generally neglected in this country. The naturalist who has sought amidst the flowers and foliage, and other external forms of plants, for characters to enable him to arrange and classify these plants, has rarely directed his inquiries to their anatomical structure, or been aware of the diversified, yet beautiful phenomena manifested in the operation of their vital functions. The near approximation of the two kingdoms of organized matter, (the animal and vegetable,) to each other, and the striking analogy which exists in the laws governing the development of each, renders the study of vegetable anatomy highly interesting, and in some degree, important to the animal physiologist. Some of the most eminent naturalists allow, that in their structure, the two kingdoms present us with no diagnostic mark by which we can separate the lower and most approximated groups of both from each other. In the phenomena exhibited by their vital functions, the analogy is equally striking. "From the most simple vegetable up to the polypus, from the most simple polypus through all the ascending scale of being up to man, the characters of life are nealy the same."†

From the researches of various eminent physiologists, it appears that all vegetable matter, when traced to its primary tissue, originates in a simple cell of inconceivable minuteness; and that, in this respect, there is identity of structure in animals and vegetables; for it is now generally allowed, by animal physiologists, that all animal tissues, however varied in form, have their origin, also, in a cellular structure.

The aid which has been derived from the study of comparative anatomy, has enabled the physiologist to make many interesting discoveries, and to settle many disputed questions, connected with the structure and functions of the human system; and such ad-

* This paper was read before the New York Φ. B. K. Society, July 24th, 1839, and the publication of it authorized, by a vote of that Society, as a part of its Transactions.

† Animal Physiology, Part I, page 20.

vances have been made in the study of vegetable anatomy and physiology, by the labors of De Candolle, Dutrochet, Lindley, and, more recently, the interesting inquiries of Carpenter, as to lead to the belief, that the day is not distant when the naturalist will discover, from the study of vegetable life, an explanation of the cause of many of those phenomena which have, hitherto, baffled the inquiries of the animal physiologist. Already the remark made by Cuvier, on the various forms and vital functions of animals, may, with equal fitness be applied to those of the vegetable kingdom; that they "are so many kinds of experiments ready prepared by nature, who adds to, or deducts from each of them, different parts, just as we might wish to do in our own laboratories, showing us herself, at the same time, their various results." This is, indeed, the only true method of studying physiology: to listen to the language of nature, as she spontaneously reveals her secrets, is far preferable to the *inquisitorial* method of extracting them from her, by cruel experiments.

But before we undertake a description of the organs of plants, or of their functions, or attempt to trace the analogy which exists between the two kingdoms, vegetable and animal, it will be necessary to make a few brief inquiries into the nature of the *primary tissues*, which enter into the structure of the vegetable formations.

The primary tissues, or elementary organs of all plants, are three in number; the *cellular tissue*, the *woody fibre*, and the *vascular tissue*, or *spiral vessels*. To these is sometimes added another tissue, denominated *ducts*. Late inquiries, however, have shown these ducts to be a variety in the form of the spiral vessels, and to be identified with them.

The *cellular tissue* enters into the composition of all vegetables. It is composed of minute, transparent vesicles, or cells, the sides of which are adherent to each other. These vesicles are exceedingly minute; varying in size, in different plants, from the 30th to the 1000th part of an inch. They generally contain an elaborated fluid, which circulates freely, in all directions, through the vegetable membrane that forms the sides of these cells. But the medium by which this circulation is carried on, has, for a long time, engaged the inquiries of vegetable physiologists. The cells do not communicate by any appreciable pores or fissures. Nothing of the kind has ever yet been discovered, although they have

been subjected to the most powerful microscopic observation. They possess another wonderful faculty, which is a self-productive quality. Each vesicle is capable of generating many others within itself.

The *woody fibre* differs from the cellular tissue, in having its vesicles considerably elongated and pointed or wedge-form at their extremities. The sides of the woody fibres possess a much greater tenuity, and are more firm and elastic than the cellular tissues. Collected into parallel bundles, and wedged together by means of their pointed extremities, they afford strength and support to the vegetable fabric, and have, therefore, been denominated the "skeleton of the plant." The ascending sap is transmitted through these vessels, yet, like the vesicles of the cellular tissue, they have no visible pores.

The *spiral vessels*, like the woody fibre, appear to have originated from the simple cell. Like the former, too, they are elongated tubes; but they possess within their tube, a spiral, woody fibre, whose coil seems destined to preserve the integrity of their calibre. The office of the spiral vessels is not fully known; but as they very generally contain air, and, with the exception of the roots, pervade almost every part of the vegetable system, their function is, undoubtedly, connected with the respiration of the plant. "A very curious analogy to this structure," says Mr. Carpenter, "is exhibited in the tracheæ, or air tubes of insects, which ramify by minute subdivisions through the whole of their bodies. These tubes are formed, like the spiral vessels of plants, of an external membrane, distended by spiral fibre, which is coiled with the most beautiful regularity."*

The *ducts*, which have been spoken of as being a modification of the spiral vessels, differ from the latter, in having no coiled fibre within their canal. Their sides are transparent, and are studded with minute dots, which give to them the appearance of perforations. Like the preceding tissues, however, they are destitute of all visible pores or openings. By some physiologists it is supposed that the dotted ducts serve to convey sap along the stem of the plant; others regard their functions, like the spiral vessels, to be connected with the respiratory system.

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* Principles of General and Comparative Physiology, by Wm. B. Carpenter.

These four primary tissues, constitute the only elementary organs which enter into the structure of vegetable formations. There are other organs connected with the phenomena of vegetable life, but they are composed of some one of these elementary tissues.

Of all the elementary organs which enter into the composition of plants, the cellular tissue is the most abundant. It is the basis of all vegetable structure, and is the only tissue that is universally present. The other forms sometimes entirely disappear, or are never developed.

The first natural division of all plants is into two grand classes, arranged according to the presence or absence of one of these primary tissues, viz. the *spiral vessels.* It has been ascertained that all flower-bearing plants, or those which are propagated by means of sexual organs, have spiral vessels; whilst those vegetables which have no flowers are destitute of spiral vessels.*

The first class is denominated *vasculares;* the latter *cellulares.* Under the head of cellular plants are included the numerous tribes of Ferns, Mosses, and Lichens; vegetables which, to the uninitiated observer, may appear of little importance in the operations of nature. Yet, without their aid, many parts of our globe, which are now teeming with vegetation and life, must have remained barren and uninhabited wastes. Some of the tribes of cellulares, as the mosses and lichens, of which there are several thousand species, may be deemed the pioneers in vegetation. They are found where no other forms of vegetable life can exist. Attached to the bare rocks of newly found countries, and islands in the ocean; springing into life on the surface of the encrusted lava, they vegetate and decay; and thus, by depositing the remains of successive generations, gradually prepare these barren surfaces for higher grades of vegetable life. "How they find their way to such places," says Dr. Lindley, "and under what laws they are created, are mysteries that human ingenuity has not succeeded in unveiling."

Both the anatomy and the physiology of vascular plants are better understood than the growth and functions of cellulares. The organs of the circulating system, also, and the course of the sap in vasculares are now very well known, whilst much doubt

* Introduction to the Natural System of Botany, by J. Lindley, &c. p. 16.

still exists in regard to the structure and functions of these organs in cellular plants. We shall therefore select a subdivision of the former class of plants, in describing the anatomy of their organs, and in tracing the analogy which exists between the vegetable and animal kingdoms.

Naturalists have discovered that there are two orders of plants belonging to vasculares, which are widely different in their anatomical structure, and in the laws which govern their development. These divisions have been termed endogenous and exogenous.

Endogenous plants are cylindrical, and are destitute of bark. Their development is by an annular deposition of new ligneous matter *within* the cylinder. The palm, the cane, corn, and the various grasses, are examples of endogenous plants. Exogenæ compose a much larger, and a more interesting class. They include all the trees of our forests, for the protection of whose external surface nature has provided a bark. The reason for this provision will appear, when it is known that the growth of trees depends upon a deposition of new materials upon the outside of the wood, and between it and the bark.

All exogenous plants, of which class the oak, the elm, the pine, the beach, &c. are examples, are composed of five principal parts; the medulla or pith, the medullary sheath, the wood, the bark, and the medullary rays.

It has been said that only four primary tissues enter into the organization of vegetable structure, viz. the cellular tissue, the woody fibre, the spiral vessels, and the ducts. The pith, which is the central portion of the plant, is composed of vesicles of the cellular tissue; neither spiral vessels or woody fibre enter into its composition. The vesicles of the medulla are slightly bound together; and their walls, according to the opinion of some physiologists, are covered with minute globular bodies, which are regarded as the nervous organs of the plant.*

No part of the ascending sap passes through the pith; but its cells are filled with an elaborated, nutrient fluid, which being disseminated in spring-time, serves to nourish the early buds, until they are sufficiently developed to procure nourishment for themselves. How far the pith may be considered as the special seat

* Recherch. Anat. et Physiol. sur la Struct. &c.

of vegetable life, and analogous to the nervous system in animals, is still an interesting question for the vegetable physiologist.

Immediately surrounding the pith is the medullary sheath. Whilst the former is composed of cellular tissue, the latter consists of spiral vessels and ducts. The office of the medullary sheath is not well understood. Lindley, who believed it to be in direct communication with the leaf-buds, and the veins of the leaves, supposed that it was the medium through which the ascending sap is transmitted to the leaves. Dutrochet and some other physiologists are of the opinion that the office of circulating the ascending sap is confined to the lymphatic tubes of the woody fibre, and that the spiral vessels of the medullary sheath belong to the function of respiration. As these vessels are found almost invariably to contain air; and, moreover, have direct communication with the leaves, which are in fact the lungs of the plant, it is more than probable that the opinion of Dutrochet is correct.

Deposited in concentric layers around the medullary sheath, and lying immediately upon it, is the wood. It is composed of cellular tissue, woody fibre, and ducts. Each year a distinct layer is deposited. The concentric layer of the first year, or the one lying in immediate contact with the medullary sheath, consists of woody fibre and ducts; but each succeeding layer has an interior membrane of cellular tissue, (the same tissue of which the pith is composed,) and an external stratum of woody fibre and ducts. The wood is usually subdivided into the denser portion, which is called *lignum;* and external to this, a softer portion called *alburnum.*

The former consists of the internal layers surrounding the medullary sheath, which being fully formed, have ceased to afford a passage for the circulating fluid. It is also called *heart-wood.* External to this is the softer wood, called the alburnum; which is also deposited in concentric rings, between the true wood and the bark. It is through this part of the plant, the alburnum, that the fluid drawn from the earth, the ascending sap, is principally transmitted. *The bark* is composed of the same elementary tissues that enter into the composition of the wood, viz. cellular tissue, woody fibre and ducts; but whilst the layers of wood consist of an interior stratum of cellular tissue, and an outer stratum of woody fibre and ducts, those of the bark are reversed: they are composed of a layer of woody fibre and ducts inside, and of cellu-

lar tissue outside. The bark is also subdivided into three parts; the inner portion is called the *liber;* surrounding this is the *cellular envelop*, and external to all, the *epidermis.* It is through the liber, the inner portion of the bark, that the principal part of the descending sap is carried, after it has undergone those chemical changes, in its circulation through the leaves, that qualify it for giving support and nourishment to the different parts of the plant.

On making a horizontal section of the trunk, or branch of an exogenous tree, radii of cellular tissue are seen extending from the centre to the circumference of the wood. These vessels are denominated the *medullary rays.* Having their origin in the medullary sheath, and consisting of the same elementary tissue with the pith, projections of which pass through the sheath into the medullary rays, they serve to connect this central system of the plant with its circumference.

The medullary rays perform a very important function in the economy of vegetable growth. That peculiar secretion which is effused in the spring of the year, between the wood and the bark, and which separates the alburnum from the liber, is poured out by these medullary radii. This viscid secretion, when organized, is supposed to constitute the cellular portion of each concentric layer. Whilst this deposition is going on, a fibrous secretion is descending from the expanding buds, and by its adhesion to the first deposit from the medullary rays, constitutes the outer stratum of woody fibre and ducts of the new layer. Thus it will be seen, that a triple and diverse circulation is carried on, in exogenous plants, at the same time. During the vernal season, whilst the lymphatic sap is ascending in the greatest quantity, and the elaborated fluid, having undergone the necessary changes, in its circulation through the leaves, is descending and depositing its nutritious particles in the different parts of the plant, this transverse current is percolating through the horizontal radii, to deposit, on the exterior surface of the alburnum, a new layer of vegetable growth.

It would be interesting to trace minutely the course of the vegetable circulation, and to investigate the agency or powers by which this circulation is sustained. But the limits orginally designed for this paper will not allow of this extended inquiry. We

can only glance briefly at the course of the sap, and notice the changes which take place in this fluid, in its circulation through the vegetable system.

De Candolle discovered that the roots of exogenous plants were terminated by small organic bodies, composed of cellular tissue and woody fibre, enclosing in their centre a minute bundle of ducts. These bodies, which are termed *spongioles*, possess the power of absorbing fluids from the earth with wonderful rapidity. This power has been denominated *endosmose*, by Dutrochet, who discovered, by some ingenious experiments, that the accumulation of a fluid in organic cavities, like the cells of plants, imparted to those bodies a vital principle by which their cavities were alternately emptied and replenished. It is a law of this "physico-organic action" that the denser fluid always attracts the rarer; and as the cells of plants are always filled with a matter of a denser consistence than water, this fluid, which always surrounds the roots of trees, is drawn up by the spongioles with great rapidity. This action possesses the property of rendering turgid the contents of these cavities, when once imbibed, so that a constant endosmose is kept up. Professor Daubeny, by some curious experiments, demonstrated that the roots of plants possess the power of selecting such materials as are required for their nourishment and growth, and of rejecting matter whose introduction into their tissues would prove deleterious to the plant. In almost all plants, however, the ascending sap is found to be nearly uniform in its composition; consisting of water, holding in solution various mineral substances, with atmospheric air. Having once entered the spongioles, the sap is conveyed along in its vertical current from one vesicle to another by this *endosmometric* property of the tissues of the plant, until it arrives at the leaves, where by its exposure to the atmospheric air it undergoes a chemical change, which prepares it to afford vitality and nourishment to the plant. This process is considered by physiologists as strictly analagous to the respiration of animals.

The phenomena connected with the respiration of plants, or the changes produced upon atmospheric air by vegetables, are highly curious and interesting. It was ascertained many years ago, by Bonnet, Priestley, and others, that healthy plants exposed to solar light, were constantly evolving oxygen gas. But the

manner in which this gas was produced, whether it was generated by the plant or taken from the atmospheric air and afterwards discharged, remained an unsettled question until the experiments of Sennebier, De Candolle, and other vegetable physiologists, proved that in this process are involved some of the most important laws of vegetable life. By the experiments of these philosophers it was proved that during the night oxygen is absorbed by the leaves of the plant, which combining with the carbon previously brought up from the earth in the ascending sap, is converted into carbonic acid. On the return of solar light, a decomposition takes place; the oxygen is evolved, and the carbon is retained for the nourishment of the plant. "It is evident," says Roget, "that the object of the whole process is to obtain carbon, in that precise state of disintegration to which it is reduced at the moment of its separation from carbonic acid, by the action of solar light, on the green substance of the leaves; for it is in this precise state alone that it is available in promoting the nourishment of the plant, and not in the crude condition in which it exists when it is pumped up from the earth along with the water which conveys it into the interior of the plant."*

The amount of oxygen given off during the day, is much greater than the quantity which is absorbed during the night. Much of the carbonic acid of the atmosphere is also decomposed by the leaves of plants; the carbon is retained, and the oxygen is evolved. Hence it is that the growth of healthy plants exercises a purifying influence upon the surrounding atmosphere, and beautifully adapts it to the respiration of animals.

Besides this decomposition of carbonic acid, various other chemical changes are wrought upon the sap, and the materials contained in the sap, in their circulation through the leaves. A part of the water is decomposed, and by the various combination of its elements with the different mineral substances which it held in solution, those vegetable products are formed which are suited for the further growth and development of the plant. Thus will be seen the beautiful and perfect analogy which exists between the circulation in vegetables and animals. The ascending sap, like the venous blood in its circulation through the lungs, having been

* Animal and Vegetable Physiol. Vol. II, p. 31.

renovated in passing through the leaves, by its combinations with atmospheric air, returns, and, like the arterial fluid, penetrates every part of the vegetable fabric, and deposits in each tissue its appropriate nourishment.

In glancing thus briefly at the organisms and functions of animals and vegetables, it will be seen that there is identity of structure and unity of function existing, throughout, between the two kingdoms. "Perhaps," says Professor Henslow, "until the contrary shall have been proved, we may consider the addition of *sensibility* to the living principle, as the characteristic property of animals." But as he defines this characteristic property of animals to be "a quality by which the individual is rendered conscious of its existence, or of its wants, and by which it is induced to satisfy those wants by some act of volition,"* we are inclined to the belief, however difficult it may be to demonstrate it, that a quality strictly analogous, in its results, to this property in animals, belongs to vegetables!

During a residence of several years in the country, we have watched the growth and studied the habits of some of the exogenous plants, with the highest interest; and it is our intention to close this paper with some observations made upon one of the most common specimens of exogenous trees.

It is well known to botanists that some species of plants attach themselves, apparently from choice, to barren surfaces, and vegetate with surprising vigor. They even possess the power of excavating crevices for the attachment of their roots in the calcareous rocks to which they fasten themselves. This is the case with some tribes of lichen. Possessing the power of secreting an acid from their roots, which acts upon the carbonate of lime, they are thus enabled gradually to imbed themselves into the surface of the rock itself.† Some trees, also, of the exogenous class, as the *Ulmus Americana*, or common elm of this country, not only flourish best in mountainous regions, and where the soil is thin, but they are often seen growing upon the limestone ledges, where but little soil is found for the attachment of their roots. One of these trees had sprung up, and had attained some magnitude, on the thinly soil-clad surface, and near the edge of a broad calca-

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* Principles, page 8. † Roget, page 39, et seq.

reous rock. From one side of the base of the tree the rock gradually sloped off towards the earth, into the soil of which the roots of the elm had imbedded themselves. On the opposite side, and within a few feet of the tree, the rock was abruptly broken off by a perpendicular descent of many feet. Over this edge of the bare rock a large root of the elm had crept, and when first seen by the writer, several years ago, was apparently seeking to hide itself in the soil below; but a distance of several feet still intervened between the root and the earth. This singular and unnatural position of the root attracted our attention at the time, and being in the vicinity of the tree two or three years afterwards, we visited it, and found that this wandering root had literally *retraced its steps.* It had actually bent directly back upon itself, and passing by the tree, had buried itself in the earth, along with its fellows, on the side opposite from where it sprang. Here certainly a "want" existed, and although we cannot, in strict philosophy, accord to vegetables the power of "volition," yet this want was satisfied by an act, or quality, analogous to the act of volition in animals.*

In another instance, this quality, or vital principle, was manifested in a still more striking manner. About fifteen years ago, upon the top of an immense bowlder of limestone, some ten or twelve feet in diameter, a sapling elm was found growing. The stone was but slightly imbedded in the earth; several of its sides were raised from four to six feet above its surface; but the top of the rock was rough with crevices, and its surface, which was sloping off, on one side to the earth, was covered with a thin mould. From this mould, the tree had sprung up, and having thrust its roots into the crevices of the rock, it had succeeded in reaching the height of some twelve or fifteen feet. But about this period, the roots on one side became loosened from their attachment, and the tree gradually declined to the opposite side,

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* "Plants," says Hugo Reid, in an attempt to draw a line between the animal and vegetable kingdoms, "have no consciousness of existence, no experience of any wants, no power of selecting food." (Science of Botany, page 16.) Yet this same author afterwards says: "Carbon, it is well known, is absolutely necessary for the support, and growth of vegetables, and when this element is not to be found in the soil, *they can extract it from the atmosphere, and assimilate it to their substance.*" The Science of Botany; by Hugo Reid, p. 53.

until its body was in a parallel line with the earth. The roots on the opposite side, having obtained a firmer hold, afforded sufficient nourishment to sustain the plant; although they could not, alone, retain it in its vertical position. In this condition of things, the tree, as if "conscious of its wants," adopted (if the term may be used) an ingenious process, in order to regain its former upright position. One of the most vigorous of the detached roots, sent out a branch from its side, which passing round a projection of the rock, again united with the parent stalk, and thus formed a perfect *loop* around this projection, which gave to the root an immovable attachment. The tree now began to recover from its bent position. Obeying the natural tendency of all plants to grow erect; and sustained by this root, which increased with unwonted vigor, in a few years, it had entirely regained its vertical position; elevated, as no one could doubt, who saw it, by the aid of the root which had formed this singular attachment. But this was not the only *power* exhibited by this remarkable tree. After its elevation it flourished vigorously for several years. Some of its roots had traced the sloping side of the rock to the earth, and were buried in the soil below. Others, having imbedded themselves in its furrows, had completely filled these crevices with vegetable matter. The tree still continuing to grow, concentric layers of vegetable matter were annually deposited between the alburnum and liber, until by the force of vegetable growth alone, the rock was split, from top to bottom, into three nearly equal divisions, and branches of the roots were soon found, extending down, through the divisions into the earth below. On visiting the tree, a few months since, to take a drawing of it, we found that it had attained an altitude of fifty feet, and was four and a half feet in circumference at its base. Having overcome obstacles which do not ordinarily impede vegetable growth, by the manifestation of a principle, and a power, not ordinarily developed in vegetation, it was towering upwards, and stretching its branches abroad as if ambitious to take its place among the loftiest trees of the forest.

As no trace of a nervous system has, as yet, been discovered in vegetables, the spontaneous motions which they occasionally exhibit, and the various changes produced by their functions, are generally referred, by naturalists, to the *organic sensibility*, or

vital energies of vegetation. The process of nutrition, secretion, and the circulation—processes, which are "highly complex, and elaborate in plants," and which are influenced by a nervous agency in animals—are carried on in vegetables by some power, or agency, as yet, imperfectly understood; but which, in its nature and results, is strictly analogous to the ganglionic system of nerves in animals.

We would not, however, be understood to express the opinion that plants, either possess the power of volition, or, that their vital movements are actually influenced by a nervous system. This is not our belief. But we have long been of the opinion, that there are vital energies, or properties, developed in the growth of vegetables, which are influenced by laws, that, as yet, are imperfectly understood;—laws which cannot be explained by any of the known phenomena of organic chemistry.

This subject still offers a wide and an interesting field for investigation. "On man," says a late elegant philosopher, "has been conferred the high privilege of interpreting the characters of the book of nature, and of deriving from their contemplation, those ideas of grandeur and sublimity, and those emotions of admiration and of gratitude, which elevate and refine the soul, and transport it into regions of pure and more exalted being."

> Trees and flowers
> Are social and benevolent, and he
> Who oft communeth in their language pure;
> Roaming among them, at the cool of day,
> Shall find like him who Eden's garden drest,
> His Maker there to teach his listening heart!

ART. X.—*Practical Remarks on Gems, especially on some of those found in the United States;* in a letter addressed to C. A. LEE, M. D., and by him communicated for insertion in this Journal; by THOMAS TABER, a practical Jeweller.

Dear Sir,—The following remarks relate principally to the second class of Gems, of which many localities in our own and neighboring states furnish no despicable supply. I have received a number of choice specimens from Chester County, Penn.,

which locality and its vicinity may be said literally to abound with those I am about to enumerate; many of them, which I have had cut and polished, would not suffer in comparison, with some of the highly prized European and Asiatic gems—productions of the same family.

Among these may be named the *Chrysoprase, Amethyst, Cairn-gorm, White Crystal, Brown Crystal, Precious Garnet, Chalcedony, Jasper, Corundum, Hypersthene, Red Oxide of Titanium, Sphene,* (to which this is nearly allied,) and *Spinelle,* together with the *Beryl, Zircon* and *Jade,*—the last three now fallen into disuse.

1. *Chrysoprase* is a very pretty second class gem of a delicate pea or apple green color, a good deal thought of by the jewellers, and used by them in every form, from the humble stomacher pin to the peerless tiara and aigrette. It looks however to best advantage when set in filagree, the dead yellow of which forms a pleasing contrast with its bright and agreeable green. Having a vitreous lustre, and hardness like quartz, it is in frequent requisition for signets and the like,—the demand varying with the fashion; but it is at all times considered a valuable stone. It is mentioned in Revelations as the tenth foundation stone of the heavenly Jerusalem. In some of the European countries it is worn as an amulet, and is like all other beautiful stones, successfully imitated.

2. The *Amethyst,* (*Violet Quartz.*) This was worn by the ancients as an amulet against intoxication. It varies in shade from a delicate pink or lilac, to a deep purple, sometimes approaching to a dark blue; the latter is called "oriental,"* notwithstanding its being frequently found in northern Europe, and in many parts of Germany. Some call this stone "sapphire," but sapphire is much harder and certainly a far greater rarity.

Amethyst I believe to be the softest of the quartz family, having found when setting this stone with a hard or ordinary file, and subsequently polishing the setting with rotten stone on threads, the facets considerably grubbed or rounded. This is also used by the jewellers in every form that taste or fancy dic-

* *Oriental* was at first a geographical epithet, but is now used as a term of excellence.—Eds.

tates,—from the modest pin, to the ducal coronet, and imperial crown. It is well adapted for seal engraving, and on it coats of arms, crests, cyphers, &c. appear to great advantage. There are said to be in many of the European museums, some very fine cameos and intaglios, which have been cut on this stone. It forms a pretty connecting link between the pink topaz and the deep rich maroon of the carbuncle. Sunlight and heat are very injurious to its beauty, by causing it to fade, apparently extracting its color, and diminishing its lustre, as exposure for any length of time in a window has fully proved. This stone too is mentioned in Scripture, and was appointed in Exodus for the ninth stone or third in the third row of the high-priest's breastplate. It is also frequently required for the making up of posy or acrostic jewelry, as it is called. In England, when making a present of a ring or brooch, they have a delicate way of expressing a sentiment, that of arranging the stones in setting, so as to spell a word, a name, or a sentence; for example, the initial letters of the following stones when combined will form the word REGARD.

Ruby, Emerald, Garnet, Amethyst, Ruby, Diamond.

This together with some word or name, is made up into a half-hoop finger ring. When a sentence is desired, the stones are either set entirely round the finger, or a large centre stone or glass for the hair, or for a breast pin.

The imitations of this stone are so perfect as readily to deceive; but upon close examination small globules of confined air can be readily perceived; the best method for the unpractised is to have recourse to the file; this is at all times the only unerring test, all imitations of gems being scratched by that instrument.

3. *Cairn-gorm, (Citrine, Yellow Crystal or Quartz, Bohemian Topaz, &c.)* This is one of the beautiful inferior gems, passing insensibly from a pale straw to a bright yellow and deep orange color, and is held in much esteem on account perhaps of its close resemblance to the topaz; it however possesses a sufficient individuality whereby one of small experience in these matters may be able to distinguish the difference. It rarely or never exhibits the delicate though rich tinge of fawn or buff, which is the general characteristic of this gem. It is very transparent, and in constant demand for seals, cane tops, ear rings, breast pins, finger

rings, bracelets, &c., &c. Any and every device has been cut on this stone and with good effect: the contrast of the unpolished engraving with its natural brilliancy is very striking; stones are sometimes cut from this substance to imitate the rose diamond with the star and pavilion facet, and palmed off as yellow roses.

4. *White Crystal, (Limpid Quartz, Nova Mina, British Diamond or Rock Crystal.)* It bears a very high polish, is perfectly transparent, and is in reality second only to the diamond. This is used for the under parts of doublets, and is the base of all the imitative gems. It much used in jewelry of all kinds—shows a beautiful play of colors when set in clusters, and is cut for seal stones and desk seals; also for dagger, knife handles and the like, and being so completely a transparent medium, is polished by the optician for spectacles. It is said to be less trying to the eyes than glass, which is not the only advantage derived from using it in this way; it being considerably harder than glass, is not easily dimmed by scratches. This is found in great abundance in many places in the United States, and often appears fully equal to the best Alpine or Madagascar specimen.

5. *Brown Crystal, (Smoky Quartz.)* Some make a groundless distinction between the brown and smoky varieties. The smoky appears perhaps a little darker in the rough, but there is certainly no difference when polished, with the exception that the one may be a shade deeper than the other—they still are both brown. I have a very fine specimen, cut as a large seal stone from Lancaster Co., Pa.—beautiful as any similar thing from Scotland. This is frequently cut like a rose diamond and sold for jargon or zircon; and the better to deceive, odd shapes are selected and artificial defects introduced. At one time, also, an extensive traffic was carried on among the jewellers, by coloring this stone and calling it "Egyptian ruby;" but this no longer being a secret, the practice is discontinued. I remember also to have seen it when in England, cut thin like a garnet and painted and backed with garnet foil, which it not only imitated, but excelled the finest vinegar garnet I ever saw; and to render the illusion more complete, a hole is sometimes drilled in the centre, into which a turquoise is inserted—this being the expedient resorted to, to fill up the holes in real garnets, the finest and largest of which come drilled as beads to evade a heavy British duty. A

large centre of brown crystal encircled with aquamarines set transparent, or without a back, has a very pleasing effect.

6. *Garnet Precious, (Carbuncle, Almandine, Vermilion, Pyrope, &c.)* This is of a rich blood red or crimson color, with sometimes a shade of brown or mixture of bluish yellow; this kind is called by the lapidary, vinegar garnet. It is more transparent than the rest and a much better foil stone. All of them, however, are in constant demand for jewelry of all kinds, and justly so, it being a rich and beautiful stone, and always looks well under every form. This stone is found abundantly in the neighborhood of West Chester, and is one of those upon which very excellent engravings have been executed.

7. *Chalcedony.* There are more varieties perhaps of this than any other stone known; the most common is called white carnelian. In some parts of New York and Pennsylvania it is very abundant, and some specimens of it are very choice The pieces I have had polished are very beautiful, differing from any I have hitherto seen, being mottled or clouded with buff, brown, and black, on a semi-transparent ground. This stone is mentioned in Scripture, and was in higher esteem formerly than at the present time. It is put to a variety of uses, being sometimes cut up for burnishers, letter weights, bell pulls, mortars, umbrella, cane, knife, dirk, and parasol handles; also for snuff boxes, seals, pins, &c. It has also been frequently employed for engraving or cutting bas reliefs.

8. *Jasper* has some resemblance to chalcedony, having a similar hardness and taking an equal polish, and is perhaps only a variety of the above; at any rate they are frequently, if not generally, found together or passing into each other, rendering it difficult to know where the one ends and the other begins. There is however one important distinction that must not be overlooked; chalcedony is generally translucent and rarely quite opake, whereas jasper is never translucent, but always opake, for it contains a large proportion of iron which forms its coloring matter. It is cut up into very handsome pin and seal stones resembling to a degree the Scotch and Egyptian pebbles. This stone also is spoken of in holy writ. I have some very good specimens of jasper which I found at Hoboken, N. J.—they take a high polish.

9. *Corundum.* This mineral being essentially the same as emery, is used by cabinet makers and others as a substitute for

emery paper; it is also used extensively for the polishing of cutlery, and even of some of the gems. It occurs in long six-sided crystals, and in other forms in which the original crystals are so abraded that their form cannot be distinguished; in color it is very dull, sometimes of an indefinable brown, green, red and gray.

10. *Hypersthene,* is the very opposite of corundum in consistency, being as soft as the other is hard; neither is it so useful, though it is said sometimes to have figured in jewelry. It must have made a very uninteresting appearance, as it bears but an indifferent polish. Its color is greenish black or brown; it is very abundant on the banks of the Brandywine, although of a very poor kind; but I have just seen some beautiful specimens from Massachusetts. Although it appears to be in some repute with the French, for jewelry, it is almost unknown to North American jewellers.

11. *Red Oxide of Titanium,* is used by the dentists to impart a tinge of color to their porcelain or incorruptible teeth which renders them more natural in their appearance. The color of this is a copper red, approaching to brown, of metallic lustre, and when found together with quartz, its appearance is very beautiful, sometimes passing through the crystals in minute hair-like fibres.*

12. *Sphene, (Calcareous Oxide of Titanium.)* Is but a variety of the preceding, and embraces such a range of form and color as to render it difficult of recognition, except to those well versed in the study. It is of a lustre less metallic than the above; it is opake and much harder; it may easily be mistaken for the brown garnet, which however is of greater tenacity and different structure.

13. *Spinelle.* In color it is either red, brown or black with all their intermediate shades and modifications; it is found in granular and angular fragments, and octahedral crystals; those of a crimson color are much used in fine jewelry under the name of spinelle ruby, as also the rose-red or pink, which is styled the Balas ruby; that of a violet color, closely resembles the Almandine garnet, and is known as the Almandine ruby. There are other varieties, such as the orangine or rubicelle.

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* The rulite of Middletown, in Connecticut, forms a most beautiful gem. It has recently been brought out by Prof. C. U. Shepard, from London, polished and set, and almost rivals the ruby.—Eds.

14. *Beryl*, is in our times but little esteemed for jewelry; it is of a very faulty or feathery nature, of a whitish, bluish, and yellowish or sea green color, rather dull, yet of vitreous lustre, feebly scratches quartz, and readily yields to the topaz; it is translucent but seldom transparent. Crystals of this stone have been found in Chester Co., and other places, upwards of six and even eight inches in diameter. It is frequently mentioned in Scripture; it is an inferior variety of the emerald, which greatly exceeds it in beauty. Beryl is found in very many places in the United States, and in some localities passes into the emerald, as in Maine, in Massachusetts, and at Haddam in Connecticut.*

15. *Zircon.* This like the preceding has greatly depreciated in estimation; it is much harder than quartz, is of a resinous lustre, and varies in external appearance and color, being sometimes yellowish brown, reddish green, &c. It sometimes appears as though scales of mica were intermixed. It was in much more esteem formerly than now as a gem, particularly the variety called hyacinth, which was worn in mourning apparel.

16. *Jade* is now a dead letter in the arts, and only to be met with in the cabinet of the mineralogist; there is a kind however, found in Turkey and used by the natives for dagger and scimetar handles, upon which various devices are carved; there is a great discrepancy of opinion at the present day as to what jade really is, that known to the jewellers by this name is a shining white opake mineral, and only very occasionally used by them in motto jewelry.† Whether the native productions of the United States will prove a source of international profit remains to be ascertained. There is one serious difficulty in the great difference in the cost of labor between this country and Europe. Lapidaries are at present but few in number, some of whom import polished specimens and even metal jewelry for the very purpose of breaking up and remodeling them. Stones ready cut for jewelry, may be imported from Germany, at one quarter the cost of polishing specimens furnished in New York. It is also true that the facilities are not so great here for their manufacture; there is a want of enterprise in this branch of the arts; but the

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* In New Hampshire crystals are found of a foot or more in diameter, and weighing 100 to 200 pounds.—Eds.

† The Jade of the South Seas is often of a deep leek green.—Eds.

investment of but a comparatively small capital would soon give it another complexion. We have as much water power here as they can possibly have in Oberstein or Bohemia, which are the grand marts of Europe.

Remarks.—We are happy to become acquainted with the experience of a sensible practical man like Mr. Taber, and to learn from him the state of this comparatively infant branch of manufacture among us, and especially in New York.

We should be gratified to receive similar communications from our other large cities, and especially from Philadelphia, where we suppose that all the arts relating to gems are farther advanced than any where else in this country. Mr. Taber does not mention the incomparably fine tourmalines of Paris, Maine—some of which as polished in London, and now in the hands of Prof. Charles U. Shepard, of this place, almost rival the ruby and the emerald in color and beauty, and far exceed them in size. They are we believe without a parallel in the world.* The fine spinelles and other remarkable minerals of Orange Co., New York, and of the neighboring parts of New Jersey, as well as the splendid transparent and perfect beryls of Haddam, recently brought to light by Prof. Johnston, of the Wesleyan University at Middletown, Connecticut, some of them being little inferior in beauty to the emerald, and far surpassing it in size, we suppose are unknown to our lapidaries.—*Eds.*

ART. XI.—*On the Connexion between the Theory of the Earth and the Secular Variations of the Magnetic Needle;* by JOHN H. LATHROP, Professor of Mathematics and Natural Philosophy, Hamilton College, Clinton, N. Y.

(Communicated for this Journal.)

IN the course of some geological speculations I recently had occasion to make, with a view to the application of the prevailing theory of the earth to the solution of some physical problems, I was led to consider its bearing on the phenomena of terrestrial magnetism.

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* The information received by the recent return of Prof. Shepard from London, places this beyond a doubt. Nov. 13, 1839.

By the *theory of the earth*, I mean that theory which supposes the present condition of our globe to be the result of a primitive solution of its materials by caloric and a subsequent cooling process; by far the greater portion of the earth being still in a state of fusion, with an external solid crust of some forty or fifty miles in thickness.

With the direct evidence of the truth of this theory, the readers of the Journal of Science are of course well acquainted. Passing by this direct evidence, and the other numerous and satisfactory applications of the theory to the solution of physical problems, I propose in this paper to confine my remarks to the bearings of the theory on the phenomena connected with the variation of the declination of the needle.

The observations of two or three centuries past demonstrate, as is well known, the gradual westerly motion of the line of no declination, at a rate which if uniform will complete an entire revolution in about seven hundred years. The variations in the position of the horizontal and dipping needles at any point on the earth's surface, are doubtless dependent on the same physical causes, and have a like period.

Without going at all into the question of the *nature* of the magnetic forces, it is a truth which we may take for granted in the outset, that the position of the magnetic line at any place, (that is, the position of the magnetic needle freely suspended by its centre of gravity,) is the result of the combined action of all the magnetic forces in the mass of the earth, whatever the nature of these forces may be. This combined action may on familiar dynamical principles be resolved into the two sets of magnetic forces, namely, those contained in the solid crust of the earth, and those exerted by the internal fluid mass. Considering the former set by themselves, the needle freely suspended would take the direction of the resultant (A) of all the magnetic influences in the solid crust. Considering the latter set by themselves, the needle would take the direction of the resultant (B) of all the magnetic influences in the internal fluid mass. The actual position of the dipping needle at any given time and place, is in the direction of the diagonal between these two resultants.

Now adopting for the present as true, the hypothesis that the internal fluid mass has in reference to the external crust a westerly revolution once in about 700 years, it would seem that all

the observed consequences relative to the secular motions of the needle must of necessity follow. For the resultant (A) relatively to the observer at any place being a fixed line, the resultant (B) is movable, partaking as it must do of the westerly motion of the internal mass. If then we describe a vertical circle through the place of observation in the direction of the resultant (A) the plane of this magnetic vertical is fixed, and twice during each revolution of the fluid mass must the resultant (B) be found in this plane. Commencing with its higher position in this plane, it will pass westerly to its greatest elongation, thence easterly to its lower conjunction with the magnetic vertical, thence to its greatest easterly elongation, thence westerly to its original position. It is obvious that the needle freely suspended by its centre of gravity, taking the direction of the diagonal between the two resultants, will follow these motions of the resultant (B). Leaving the magnetic vertical at its minimum dip, passing to its greatest westerly declination, thence in its easterly progress passing said vertical at its maximum dip to its greatest declination on the other side, thence to the place of beginning. The pole of the dipping needle would thus describe a curve returning into itself, with a period equal to that of the supposed westerly revolution of the internal mass, and the secular motions of the horizontal needle in its arc of declination would have the same period.

It is obvious that if the magnetic poles of the external crust and of the internal fluid mass, were coincident with the pole of revolution, there would be no departure of the dipping or the horizontal needle from the plane of the meridian. As this coincidence does not exist in fact, the position of the magnetic pole of the solid crust will be determined by the intersection of magnetic verticals for different places, the position of such vertical at any place being determined by passing its plane through the needle when its dip is at a maximum or minimum. One only of these verticals will pass through the poles of revolution and coincide with a terrestrial meridian; and of course in all places situated on this meridian, the dip of the needle will be at a maximum or a minimum when the direction of the needle is due north and south. In all other places on the earth's surface, there will be an easterly or westerly declination of the needle when the dip is at a maximum or minimum.

Thus admitting a westerly revolution of the internal fluid mass, results analogous to observed magnetic phenomena would seem of necessity to follow.

The question then returns upon us—Does the theory of the earth require, as a necessary physical consequence, a westerly revolution of the internal fused mass?

It is a fact noticed by La Place, and indeed one of easy demonstration, that on the supposition of a gradual cooling process and a consequent diminution of the earth's radius by contraction, the diurnal revolutions of the earth would gradually become more rapid, that is, the length of our day would be gradually diminishing. Every particle of a revolving sphere, on falling towards the axis by a general contraction, tends, by preserving its absolute velocity, to a more rapid angular motion, and the period of revolution for the whole mass must be inevitably diminishing. In the case of the earth, it is true that astronomy has not detected any change in the length of our day—a fact by no means incompatible with the existence of such a change; for in the first place the extreme accuracy which now marks astronomical observations is comparatively of modern date; and secondly it is stated as the result of calculation that a contraction of the radius of the internal fused mass of one twenty fifth of an inch in a century would be sufficient to account for all the results of volcanic action at the present age of the world. That astronomy has been unable to detect the minute acceleration of the diurnal motion which has accrued since men began to converse with the stars on the plains of Chaldea, constitutes therefore no valid objection to the truth of a geological theory involving such a result. Improved methods, exact and long continued observations, will doubtless make astronomy a competent witness on this point in time to come. If the theory of the earth be true, it must be admitted as a necessary physical consequence, that the length of the day is diminishing; though the decrement at this age of the world may be inappreciable from century to century, and the records of astronomical science may as yet furnish no evidence of the fact of such diminution.

But this tendency to increased angular motion arising from contraction, must obviously be greatest in those portions of the mass of the earth which have contracted most, and least in those parts which have contracted least. Now the earth having been,

on the principles of the theory, subjected to a gradual cooling process, it is quite manifest that the contracting influences have had their principal seat of action on and near the surface, while in the interior their operation has been comparatively feeble. We seem therefore to be shut up to the conclusion, that the motion of the solid crust about the axis has been more accelerated by the cooling and contracting processes than that of the internal fused mass—that the angular velocity of the former is more rapid than that of the latter—that the latter as a whole is gradually falling back of the former. In other words, considering the solid crust as fixed relatively to the observer, there is a gradual westerly revolution of the internal fused mass.

Thus admitting the prevailing theory of the earth, we infer, as a necessary physical consequence, a westerly revolution of the internal mass; and admitting the western revolution of the internal mass, the observed secular motions of the horizontal and dipping needles would seem of necessity to follow.

In looking back on the attempts which have been made to assign the physical causes of the variation of the declination of the needle, it is curious to remark how completely the theory under consideration embodies the hypothesis of Halley; who supposed the earth to have four magnetic poles, two fixed and two movable. Regarding the resultant of the magnetic forces of the solid crust as indicating the two fixed poles, we have the two movable poles of Halley indicated by the resultant of the magnetic forces of the internal fluid mass. The hypothesis of Halley may well be set down as an instance of that grasp of mind with which "men before their time" seize upon truths, which it may require centuries of investigation fully to develop and demonstrate.

It will be observed that in this paper I have confined my remarks to the connexion between the theory of the earth and the *secular* motions of the magnetic line. I propose to make the bearing of the theory on the *subordinate* oscillations of the needle the subject of a future communication.

Hamilton College, Sept. 1839.

ART. XII.—*Notices of Tornadoes, &c.;* by ROBERT HARE, M. D., Professor of Chemistry in the University of Pennsylvania.

I. *Account of a Tornado, which passed over Providence, and the Village of Somerset, R. I., in August,* 1838.*

I PROPOSE to lay before the Society, for a place in their Transactions, an account of a tornado which occurred in the state of Rhode Island, towards the end of August last.

This phenomenon was first observed near Providence, over the south-western suburbs of which it passed in a course generally from west by north, to south by east. Only a few days subsequently I visited some of the most remarkable scenes of its ravages.

The characteristics of this tornado, from all that I could see or hear, are quite similar to those of the tornado which occurred at New Brunswick, N. J. in June, 1835, and to which I referred in my paper upon the causes of tornadoes and water-spouts, published in the sixth volume of the Society's Transactions.

This recent tornado was advantageously seen by J. L. Tillinghast, Esq. from a window of his mansion, which is so situated, on the brow of a hill on the eastern side of the city of Providence, as to afford an unobstructed view of the country opposite. Mr. Tillinghast alledges that his attention was at first attracted by seeing to the westward a huge inverted cone, of extremely dark vapor, which extended from the clouds to the earth. In the contortions and spiral movements of its lower extremity, this cone was conceived to resemble the proboscis of an enormous elephant, moving about in search of food. Sometimes it was elongated so as to reach the ground; at others it skipped over the intervening space without touching it; but at each contact with the terrestrial surface or bodies resting thereon, a cloud of dust intermingled with their fragments, was seen to rise within the vortex. To those who were sufficiently near to the meteor, a fearful explanation of these appearances was simultaneously evident. Ponds were partially exhausted. Trees uprooted or deprived of their leaves or branches. Houses were unroofed, or uplifted and then dashed to pieces. Farms were robbed of their grain, potatoes,

* From the Transactions of the American Philosophical Society.

fruit trees or poultry: nor were human beings secure from being carried aloft, and more or less injured by subsequent descent. It was alledged that at Somerset two women were carried from a wagon over a wall, into an adjoining field. Within the same village a cellar door frame, with its doors bolted, was lifted, and then deposited on one side of its previous position; although situated to windward of the mansion to which it belonged. This result was the more striking, because, in consequence of their presenting an inclined plane to the blast, the doors and their frames would have been pressed more firmly upon their foundation by an ordinary wind. In consequence of the same dilatation of the air within the house, which lifted the cellar door, the weather-boarding on the leeward side was burst open, while that to the windward was undisturbed.

About four o'clock on the afternoon during which this tornado passed near Providence, there was heard at the farm at which I resided, twenty-five miles south of Providence and about fifteen miles from Somerset, the loudest thunder which I ever experienced. It made the house in which I was tremble sensibly.

I have received from an estimable friend, Mr. Allen, a most interesting account of this tornado, which passed over the river, and there produced the appearance of a water-spout, while he was sufficiently near for accurate observation. In one respect his narrative tends to justify my opinion, that the exciting cause of tornadoes is electrical attraction. In two instances in which flashes of lightning proceeded from the water, Mr. Allen remarked that the effervescence produced by the tornado in the water very perceptibly subsided.*

Extract from a Letter written by Zachariah Allen, Esq., of Providence.

"It was about three o'clock, P. M., during a violent shower, that I observed a peculiarly black cloud to form in the midst of light, fleecy clouds, and to assume a portentous appearance in the heavens, having a long, dark, tapering cone of vapor extending from it to the surface of the earth. The form of this black cloud, and of the cone of vapor depending from it, so nearly resembled

* See Essay on the Cause of Tornadoes or Water-spouts in sixth vol. American Philosophical Transactions, or in Silliman's Journal, vol. 32, for 1837.

the engraved pictures of 'water spouts' above the ocean, which I had frequently seen, that I should have come speedily to the conclusion that one of these 'water spouts' was approaching, had I not been aware that this phenomenon occupied a space in the heavens directly over a dry plain of land. Whilst attentively watching the progress of the cloud, with its portentous dark cone trailing its point in contact with the surface of the earth, I noticed numerous black specks, resembling flocks of blackbirds on the wing, diverging from the under surface of the clouds, at a great elevation in the air, and falling to the ground. Among these were some objects of larger size, which I could discern to be fragments of boards, sailing off obliquely in their descent. This alarming indication left no room for doubt that a violent tornado was fast approaching, and that these distant, dark specks were fragments of shingles and boards uplifted high in the air, and left to fall, from the outer edge of the black conical cloud. This fearful appearance was repeatedly exhibited, as often as the tornado passed over buildings.

"The whirlwind soon swept towards an extensive range of buildings, within a few yards of me, the roof of which appeared to open at the top, and to be uplifted for a moment. The whole fabric then sunk into a confused mass of moving rubbish, and became indistinctly visible amid the cloud that overspread it, as with a mantle of mist.

"The destructive force of the tornado now became not only apparent to the eye, but also fearfully terrific, from the deafening crash of breaking boards and timbers, startling the amazed spectator in alarm for his personal safety, amid the roar of the whirlwind, and the shattered fragments flying like deadly missiles near him. At one instant, when the point of the dark cone of cloud passed over the prostrate wreck of the building, the fragments seemed to be upheaved, as if by the explosion of gunpowder, and I actually became intensely excited with the fear that the moving mass might direct its march towards the open area of the yard, to which I had resorted, after abandoning a building in which I had previously found shelter.

"Fortunately the course of the tornado was not over the building used as a depot by the Stonington Rail-road Company in Providence, where there was a numerous assemblage of passengers awaiting the departure of the cars; otherwise several lives might have been lost.

"The most interesting appearance was exhibited when the tornado left the shore, and struck the surface of the adjacent river. Being within a few yards of this spot, I had an opportunity of accurately noting the effects produced on the surface of the water.

"The circle formed by the tornado on the foaming water was about three hundred feet in diameter. Within this circle the water appeared to be in commotion, like that in a huge boiling cauldron; and misty vapors, resembling steam, rapidly arose from the surface, and entering the whirling vortex, at times veiled from sight the centre of the circle, and the lower extremity of the overhanging cone of dark vapor. Amid all the agitation of the water and the air about it, this cone continued unbroken, although it swerved and swung around, with a movement resembling that of the trunk of an elephant whilst that animal is in the act of depressing it to the ground to pick up some minute object. In truth, the tapering form, as well as the vibrating movements of the extremity of this cone of vapor, bore a striking resemblance to those of the trunk of that great animal.

"Whilst passing off over the water, a distant view of the cloud might have induced the spectator to compare its form to that of a huge umbrella suspended in the heavens, with the column of vapor representing the handle, descending and dipping into the foam of the billows. The waves heaved and swelled, whenever the point of this cone passed over them, apparently as if some magical spell were acting upon them by the effect of enchantment. *Twice I noticed a gleam of lightning, or of electric fluid, to dart through the column of vapor, which served as a conductor for it to ascend from the water to the cloud. After the flash the foam of the water seemed immediately to diminish for a moment, as if the discharge of the electric fluid had served to calm the excitement on its agitated surface.*

"The progress of the tornado was nearly in a straight line, following the direction of the wind, with a velocity of perhaps eight or ten miles per hour.

"Near as I was to the exterior edge of the circle of the tornado, I felt no extraordinary gust of wind; but noticed that the breeze continued to blow uninterruptedly from the same quarter from which it prevailed before the tornado occurred.

"I also particularly observed that there was no perceptible increase of temperature of the air adjacent to the edge of the whirlwind, which might have caused an ascending current by a rarefaction of a portion of the atmosphere. After passing over the sheet of water, and gaining the shore, I observed the shingles and fragments of a barn to be elevated and dispersed high in the air; and the dark cloud continued to maintan the same appearance which it at first presented, until it passed away beyond the scope of a distinct vision of its misty outlines.

"The above imperfect sketch can convey to your mind only a feeble impression of this exciting scene, which in passing before me excited just enough of terror to impart to the spectacle the most awful sense of the power, sublimity and grandeur of the Almighty, as described in the glowing words of the Psalmist. 'He bowed the heavens also, and came down; and darkness was under his feet; and he did fly upon the wings of the wind. He made darkness his secret place; his pavilion round about him were dark waters and thick clouds of the skies.'"

II. *At Chatenay, near Paris.*

To the Editors of the National Gazette.

Messrs. Editors—You had published a memoir on tornadoes by a distinguished foreigner, Œrsted. Conceiving the impression conveyed by that article less worthy of consideration than those which had been presented in a memoir which I had previously published, I hope that I shall be considered as having had a sufficient incentive for endeavoring through the same channel to correct the erroneous impressions which that memoir was in my opinion of a nature to produce.

In my letter to you of the 26th ult. it was stated that I considered tornadoes as the consequence of an electrical discharge superseding the more ordinary medium of lightning. From an article which has since met my attention in the Journal des Debats, published on the 17th of July at Paris, it appears that a tremendous tornado occurred about the last of the preceding June in the vicinity of that metropolis. The losers applied for indemnity to certain insurers, who objected to pay on the plea that the policies were against thunder storms not against tornadoes. This led to an application to the celebrated Arago, who referred the case to another savant, Peltier.

From the report of Peltier, of which I subjoin a translation, it will be seen that, excepting his neglect of the co-operative influence of the elasticity of the air, he sanctions my opinion that a tornado is the effect of an electrical discharge.*

"Yesterday," says Peltier, "I visited the commune of Chatenay in the canton of Ecouen, department of Seine and Oise, and investigated the disasters experienced in the month of June last, from a tornado which first originated over the valley of Fontenay des Louvres. At present I can give only a summary account of this wonderful phenomenon.

"Early in the morning a thunder cloud arose to the south of Chatenay, and moved at about ten o'clock over the valley between the hills of Chatenay and those of Ecouen. The cloud having extended itself over the valley, appeared stationary and about to pass away to the west. Some thunder was heard but nothing remarkable was noticed, when about midday a second thunder storm coming also from the south and moving with rapidity advanced towards the same plain of Chatenay. Having arrived at the extremity of the plain above Fontenay, opposite to the first mentioned thunder cloud, which occupied a higher part of the atmosphere, it stopped at a little distance, leaving spectators for some moments uncertain as to the direction which it would ultimately take. That two thunder clouds should thus keep each other at a distance, led to the impression that being charged with the same electricity, they were rendered reciprocally repellent, and that a conflict would ensue in which the terrestrial surface would play an important part. Up to this time there had been thunder continually rumbling within the second thunder cloud, when suddenly an under portion of this cloud descending and entering into communication with the earth, the thunder ceased. A prodigious attractive power was exerted

* I had presented copies of the pamphlet containing my memoir to M. Arago and several other members of the Institute. In a subsequent conversation he referred to some of the suggestions which it contained. As it conveyed a view of the question decisively favorable to the claimants, it may be inferred that it must have been alluded to by Arago and thus have become the source of Peltier's impressions. It may therefore be anticipated that due acknowledgment will be hereafter made by him when he realizes his promise of making a more elaborate report on the tornado of Chatenay. Before entering upon the arguments by which I sustained my hypothesis it was briefly stated in the following words: "*After maturely considering all the facts I am led to suggest that a tornado is the effect of an electrified current of air superseding the more usual means of discharge between the earth and clouds, in those vivid sparks which we call lightning.*"

forthwith, all the dust and other light bodies which covered the surface of the earth mounted towards the apex of the cone formed by the cloud. A rumbling thunder was continually heard. Small clouds wheeled about the inverted cone rising and descending with rapidity. An intelligent spectator, M. Dutour, who was admirably placed for observation, saw the column formed by the tornado terminated at its lower extremity by a cap of fire; while this was not seen by a shepherd, Oliver, who was on the very spot, but enveloped in a cloud of dust.

"To the southeast of the tornado, on the side exposed to it, the trees were shattered, while those on the other side of it preserved their sap and verdure. The portion attacked appeared to have experienced a radical change, while the rest were not affected. The tornado having descended into the valley at the extremity of Fontenay, approached some trees situated along the bed of a rivulet, which was without water though moist. After having there broken and uprooted every tree which it encountered, it crossed the valley and advanced towards some other trees, which it also destroyed. In the next place, hesitating a few moments as if uncertain as to its route, it halted immediately under the first mentioned thunder cloud. This although previously stationary, now began as if repelled bythe tornado, to retreat towards the valley to the west of Chatenay. The tornado after stopping as I have described, would infallibly on its part, have moved on towards the west to a wood in that direction, if the other thunder cloud had not prevented it by its repulsion. Finally it advanced to the park of the castle of Chatenay, overthrowing every thing in its path. On entering this park, which is at the summit of a hill, it desolated one of the most agreeable residences in the neighborhood of Paris. All the finest trees were uprooted, the youngest only, which were without the tornado, having escaped. The walls were thrown down, the roofs and chimneys of the castle and farmhouse carried away, and branches, tiles and other movable bodies, were thrown to a distance of more than five hundred yards. Descending the hill towards the north, the tornado stopped over a pond, killed the fish, overthrew the trees, withering their leaves, and then proceeded slowly along an avenue of willows, the roots of which entered the water, and being during this part of its progress much diminished in size and force, it proceeded slowly over a plain, and finally at the distance of more than a thousand

yards from Chatenay, divided into two parts, one of which disappeared in the clouds, the other in the ground.

"In this hasty account I have, with the intention of returning to this portion of the subject, omitted to speak particularly of its effect upon trees. All those which came within the influence of the tornado, presented the same aspect; their sap was vaporized, and their ligneous fibres had become as dry as if kept for forty eight hours in a furnace heated to ninety degrees above the boiling point. Evidently there was a great mass of vapor instantaneously formed, which could only make its escape by bursting the tree in every direction; and as wood has less cohesion in a horizontal longitudinal than in a transverse direction, these trees were all, throughout one portion of their trunk, cloven into laths. Many trees attest, by their condition, that they served as conductors to continual discharges of electricity, and that the high temperature produced by this passage of the electric fluid, instantly vaporized all the moisture which they contained, and that this instantaneous vaporization burst all the trees open in the direction of their length, until the wood, dried up and split, had become unable to resist the force of the wind which accompanied the tornado. In contemplating the rise and progress of this phenomenon, we see the conversion of an ordinary thunder gust into a tornado;* we behold two masses of clouds opposed to each other, of which the upper one, in consequence of the repulsion of the similar electricities with which both are charged, repelling the lower towards the ground, the clouds of the latter descending and communicating with the earth by clouds of dust and by the trees. This communication once formed, the thunder immediately ceases, and the discharges of electricity take place by means of the clouds which have thus descended, and the trees. These trees, traversed by the electricity, have their temperature, in consequence, raised to such a point that their sap is vaporized, and their fibres sundered by its effort to escape. Flashes and fiery balls and sparks accompanying the tornado, a smell of sulphur remains for several days in the houses, in which the curtains are found discolored. Every thing proves that the tornado is nothing else than a conductor formed of the clouds, which serves as a passage

* See 5th vol. of the American Philosophical Transactions, or Silliman's Journal for 1837, vol. 32, page 154.

for a continual discharge of electricity from those above, and that the difference between an ordinary thunder storm and one accompanied by a tornado, consists in the presence of a conductor of clouds, which seem to maintain the combat between the upper portion of the tornado and the ground beneath. At Chatenay this conductor was formed by the influence of an upper thunder cloud, which forced the lower portion of an inferior thunder cloud to descend and come into contact with the terrestrial surface."

Peltier concurs with me in the opinion that the tornado supersedes lightning by affording a conducting communication between the terrestrial surface and thunder cloud: but he conceives that the cloud by its descent becomes the conductor through which the electric discharge is accomplished: whereas agreeably to the explanation which I suggested, a vertical blast of air and every body carried aloft contributes to form the means of communication. Agreeably to this suggestion the electric fluid does not pass by conduction, but "convection," as explained in my letter of the 26th ult. That the idea of the Parisian savant that the cloud acts as a conductor is untenable, must be evident, since the light matter of which a cloud is constituted could not be stationary between the earth and sky in opposition to that upward aerial current of which the violence is proved to be sufficient to elevate not only water, but other bodies specifically much heavier than this liquid.

So much of the narrative of Peltier as relates to the repulsion between the thunder clouds, is inconsistent with any other facts on record respecting tornadoes which have come within my knowledge. It should be recollected that this part of the story does not depend upon the observation of the author, and may be due to the imagination of the witnesses whom he examined. The most important part of his evidence is that respecting the effect upon the trees, which appears to me to demonstrate that they were the medium of a tremendous electrical current.

In my memoir I noticed the injury done to the leaves of trees, and stated my conviction that "*as it was inconceivable that mechanical laceration could have thus extended itself equally among the foliage, a surmise may be warranted that the change was effected by electricity associated with the tornado.*"

III.—*On Tornadoes, and Œrsted's Memoirs respecting them.*

To the Editors of the National Gazette.

Dear Sirs,—I believe it is generally admitted by electricians that the enormous discharges of the electric fluid, which, during thunder gusts, take place in the form of lightning, are the consequence of the opposite electrical states of an immense stratum of the atmosphere coated by the thunder clouds, and a corresponding portion of the terrestrial surface. In a memoir published in the 5th volume of the American Philosophical Transactions, republished in Silliman's Journal, vol. 32, for 1837, I had endeavored to show that the tornado was the consequence of the same causes producing in lieu of lightning, an electrical discharge by a vertical blast of air, and the upward motion of electrified bodies. In your Gazette of the 30th ult., you have republished an article by the celebrated Œrsted, in which it is alledged that tornadoes or water-spouts cannot be caused by electricity, because there is no evidence proving that persons exposed to them have experienced electrical shocks. To me it appears evident that the scientific author confounds the different processes of discharge to which I have alluded, the one occurring in thunder gusts, the other in tornadoes; also that he has forgotten that a shock can be given neither by a blast of electrified air, nor by a continuous electrical current, a transient interruption of the circuit being indispensable to the production of the slightest sensation of that nature. If a person, having a conducting communication between one of his hands and a charged surface of a well insulated battery, hold in the other hand a pointed wire, the battery will be discharged through him and through the wire, producing a blast of electrified air from the point, without his experiencing any shock; neither would a shock be given to any person by exposure to the blast thus produced.

This form of electrical discharge to which I ascribe tornadoes, in which electricity is conveyed from one surface to another by the motion of air or other movable bodies intervening, is by Faraday designated as "*convection*," from the Latin "conveho," to carry along with.

In the comparatively minute experiments of electricians, the process of convective discharge, is exemplified not only by the electrified aerial blast, but likewise by the play of pith balls, the

dance of puppets, or the vibration of a pendulum, or bell clapper. The passage of sparks is found to arrest or to check such movements, and in like manner the passage of lightning has been observed to mitigate the vertical force of a tornado.

While a meteor of this kind, which passed over Providence last year, was crossing the river, the water, within an area of about three hundred feet in diameter, was found to rise up in a foam, as if boiling. Meanwhile two successive flashes of lightning occurring, the foam was observed to subside after each flash. It is thus proved that a discharge by lightning, is inconsistent with the discharge by convection, and that so far as one ensues, the other is impeded.

In an account of a tremendous storm of the kind of which I have been treating, published in Silliman's Journal for July last, it is mentioned that at its commencement it was only a violent thunder gust. This is quite consistent with the experience acquired by means of our miniature experiments, in which a discharge by sparks may be succeeded by a discharge by convection, or vice versa; or they may prevail alternately. In one case the electric fluid passes in the gigantic sparks called lightning, in the other it is conveyed by a blast of electrified air. In the former case, animals are subjected to deleterious shocks, while in the latter no other injury is sustained than such as results from collision with the air, or other ponderable bodies.

In the case of the tornado, the vertical blast is accelerated by the difference between the pressure of the air at the earth's surface, and at the altitude to which the blast extends. Should this be a mile there would be a difference nearly of one hundred and forty four pounds per square foot. During the tremendous gale which prevailed at Liverpool last winter, the greatest pressure of the wind was estimated at only thirty pounds per square foot. So far as the ingenious inferences and observations of Mr. Espy, as to the buoyancy resulting from a transfer of heat from aqueous vapor to air hold good, the vertical force so alledged to arise, will co-operate to aid the influence of electric discharges by convection.

The distinguished author of the memoir alluded to at the outset of this communication, conceives that were electricity the cause of tornadoes, the magnetic needle should be disturbed by them; and without advancing any proof that such disturbance

does not take place, founds thus an objection to electrical agency. I conceive that it would be unreasonable to expect a magnetic needle to be affected by an electrified blast of air if protected from its mechanical force.

It has been shown by Faraday that without peculiar management, tending to prolong the reaction, the most delicately suspended needle cannot be made to diverge in obedience to the most powerful discharges of mechanical electricity. An electrical spark may impart a feeble magnetism, but is too rapid and transient, to affect a needle. Moreover, when a needle is at right angles to an electric current which would be quite competent to influence it if parallel to it, there can be no consequent movement, since the current tends to keep it in that relative position. The direction of every electrical discharge inducing a tornado must necessarily be nearly at right angles to the needle, since it must be vertical, while the needle is necessarily horizontal when so supported as to traverse with facility.

I do not perceive any facts or suggestions in the article by Œrsted, which are competent to render the phenomenon of which he treats more intelligible than it was rendered by the accurate survey and examination of the track of the New Brunswick tornado, by Pres. A. D. Bache, and Mr. Espy, in connexion with the accounts published by other witnesses of that and other similar meteors.

It seems to be admitted on all sides, that within a certain space there is a rarefaction of air tending to burst or unroof houses; that the upward blast consequent to this rarefaction, carries up all movable bodies to a greater or less elevation; and that an afflux of air ensues from all quarters to supply the vacuity which the vertical current has a tendency to produce. Trees within the rarefied area are uprooted and sometimes carried aloft, but on either side of it, or in front, or in the rear, are prostrated in a direction almost always bearing towards a point which during some part of the time in which the meteor has endured has been under the axis of the column which it formed.

It appears to me that all the well authenticated characteristics enumerated by Œrsted, are referable to the view of the case thus presented. This distinguished author assumes that there is a *whirling* motion, although between American observers, this is a debated question. It seems in the highest degree probable that

gyration does take place occasionally, if not usually, since in the case of liquids rushing into a vacuity, a whirlpool is very apt to ensue. But as slight causes will in such cases either induce or arrest the circular motion, such movements may be contingent. It would however appear probable that when gyration does exist, it may, by the consequent generation of a centrifugal force, tend to promote or sustain the rarefaction and thus contribute to augment the force, or prolong the duration of a tornado.

From observations made upon the track of the recent tornado at New Haven, I am led to surmise that there was more than one axis of gyration and vertical force. I conceive that in consequence of the diversities in the nature of the bodies or the soil, there was a more copious emission of electricity from some parts of the rarefied area than others. In two instances wagons with iron wheel tires and axles, were especially the objects of the rage of the elements. Trees equally exposed were unequally affected, some being carried aloft, while others were left standing. The area of a tornado track may be more analogous to a rough surface than a point, and the electricity may from its well known habitudes, be given off only from such bodies as are from their shape or nature most favorable to its evolution.

Since these inferences were made, I have observed in Reid's work upon storms, that similar impressions were created by facts observed during a hurricane at Mauritius, in 1824. It was remarked that narrow, tall and decayed buildings, ready to tumble into ruins, escaped at but little distance from new houses, which were overturned or torn into pieces. It was inferred there were local whirlwinds, subjecting some localities to greater violence than others in the vicinity. In the case of other hurricanes similar facts have been noticed.

It may be expedient here to subjoin, that I consider a hurricane as essentially a tornado, in which an electric discharge by "*convection*," associated with discharges in the form of lightning, takes place from a comparatively much larger surface. In the case of the hurricane, however, the area of the track is so much more extensive, that the height of the vertical column to the diameter of the base being proportionably less, there is necessarily a modification of the phenomena, which prevents the resemblance from being perceived. In the case of the hurricane, the column is too broad to come within the scope of a human eye.

So much has lately been presented to the public, either through the newspapers, journals, or lectures, which I consider demonstrably incorrect, that I can hardly, consistently with my love of true science, remain an inactive observer of the consequent perversion of the public mind. Unfortunately it is difficult if not impossible to discuss such subjects without a resort to language and ideas, which are too technical and abstruse for persons who have not made chemistry and electricity an object of study. I have however prepared a series of essays, in which the causes of storms are stated, agreeably to my view of this important branch of meteorology.

ART. XIII.—*On the Silurian System, with a Table of the Strata and Characteristic Fossils;* by T. A. CONRAD.

THE geological structure of the territory of the U. States is beginning to be fairly understood, through the active exertions of the State geologists. We no longer confine ourselves to the vague terms of transition and grauwacke, but are aware that many distinct formations have been so designated. Prof. Eaton has long since given names to some of these, which have been found useful, and would have been much more so, had the fossils been collected in sufficient numbers, and with great care to preserve their stratigraphical relations. But this is a work of time and labor, and could not be expected of an individual who had other duties to perform, and at a period when the transition with its beautiful fossils, and other most interesting history were almost wholly neglected even in Europe? Taking a glance at the geology of the United States, we find the Silurian system of Murchison spread over the greater portion of New York, Ohio, Indiana, Kentucky, and Tennessee, and terminating on the south in the mountainous or rather hilly region of North Alabama. In the vicinity of Florence and Tuscumbia we find the Oriskany sandstone, (as designated in the New York reports,) a rock very easily recognized by its casts and impressions of large brachiopodous bivalves, quite unlike, as a group, to any fossils above or below them. In Europe, a rock termed old red sandstone separates the Silurian from the carboniferous systems, and fortunately I have detected the same rock, and with its

characteristic fossil, the scales of a fish termed Holoptychus nobilissimus, figured in Murchison's work on the Silurian system. This rock not only holds precisely the same place between the coal and the Silurian rocks, and contains the same characteristic fossil, but is the same in color and mineral character, as the old red sandstone of England. It occurs on the rail-road near Blossburg, Tioga county, Pennsylvania, whence I received a fine specimen last spring. The carboniferous system is also well developed in this country, but the mountain limestone is rare and in thin depositions generally. The fossils, however, are numerous and well characterized in the shales and ironstone nodules. The next succeeding formation or system, the new red sandstone, is very limited, and above it we find no trace of that interesting series of rock, the oolites, lias, wealden, &c., but the cretaceous rocks are widely distributed. Finally, the tertiary formations, corresponding to the eocene, and older and newer pliocene, stretch along nearly the whole of the seaboard. I have lately ascertained that the eocene or lower tertiary occurs in the bluff at Natchez, Mississippi. The various formations, from the coal inclusive to the top of the series, have been found to correspond with those in Europe in a remarkable manner. It remains now to determine how far the correspondence between the subdivisions of the English and American Silurian rocks can be determined. As I have lately examined the splendid work of Murchison with this view, it may be interesting to geologists to learn the result, although it is necessarily as yet but an imperfect view of this important subject. Beginning, therefore, with the Llandeilo flags, I will observe that this formation in the New York geological reports was compared to the Trenton limestone, but since the examination of Murchison's work I find that the Llandeilo rocks are characterized by two species of trilobites which are extremely rare in this country, and although they occur in the Trenton limestone, I cannot but consider them as evidence that the Llandeilo rocks have been thinly deposited and subsequently swept away.

Caradoc Sandstone.

This appears to correspond with the celebrated limestone of Trenton Falls, known by the name of Trenton limestone, which occurs in many places in the northeastern portion of New York and in Canada, and passing under the upper Silurian rocks, reäp-

pears at Cincinnati, Columbus, and other places in Ohio, and terminates on the south in Tennessee. It occurs at Bedford Springs and other localities in Pennsylvania. It is a singular fact, and may be the means of lessening the faith of some geologists in the value of organic remains, that the well known trilobite, Calymene Blumenbachii is not known to occur in the Caradoc sandstone, but is here characteristic of the Trenton limestone. But we regard groups, not a single species, in comparing rocks of distant localities, and it will be found that such discrepancies occur in other formations without ever being in amount sufficient to create confusion and prevent comparison. There is one fossil figured by Murchison as a Caradoc species, which here lies immediately below the Wenlock shale. This arrangement would embrace Salmon river sandstones and shales and the Niagara sandstones, two very distinct formations, in the same division, whence I infer that the Salmon river rocks are wanting in Wales, and the Niagara sandstone very rarely present, which brings the Pentamerus rock in contact with the Caradoc sandstone. Traces of the Niagara sandstone in Wales may be recognized by the occurrence of Agnostus latus, (nob.) and Planorbis trilobatus, (Bellerophron, Sow.) which belong exclusively to this formation. It is remarkable that the Caradoc rocks should consist of sandstone in Wales, whilst the Trenton limestone and slate form so prominent a feature of the series in this country. Had it been otherwise, a more extended correspondence would probably have occurred between the fossil groups on each side of the Atlantic.

Wenlock Shale.

This formation is clearly identified with the shale of Rochester, (calciferous slate, Eaton.) It contains in considerable abundance, the Asaphus limulurus, Green, (A. longicaudatus, Murch.) Trimerus delphinocephalus, so common in this shale, is said to occur in the Wenlock limestone, but to characterize the Ludlow formation in Wales, whilst here it has never been found above the Rochester shale ; it is, therefore, a curious instance of a species having been preserved in one region after it had been destroyed in another, like the Calymene Blumenbachii.

Wenlock Limestone.

This is represented by a series of limestones admirably developed in the Helderberg mountain, of which I have noticed six,

distinguished by different groups of organic remains. They probably occupy more surface throughout the Union than any other fossiliferous rocks.

Ludlow Rocks.

These have not yet been subdivided, and they can only in a general way be compared with Murchison's group. The organic remains are in great numbers and variety, and are very unlike those of the lower Silurian rocks.

The following table is given in order to correct some errors in that published in the New York reports, and to show the relative position of certain fossils which may be regarded as characteristic species. Though the table is necessarily incomplete, great care has been taken to render it correct as far as it goes, and I trust it will be found to convey a novel view of the wonderful variety of strata, each with its peculiar organic remains, which compose the Silurian system.

OLD RED SYSTEM.

Formations.	*Characteristic Fossils.*
Old red sandstone, (Blossburg, Pa.)	Holoptychus nobilissimus.

SILURIAN SYSTEM.

Formations.	*Characteristic Fossils.*	
22. Sandstone and shales of Cazenovia, &c.	Dipleura Dekayi, Cryphæus Greenii, Pterinea fasciculata, Cyrtoceras maximum, C. giganteum, Orthis orbiculatus, Orthoceras pyriforme, and many unnamed bivalves.	Ludlow rocks.
21. Shales of Moscow and Lake Erie,	Atrypa aspera, A. concentrica, Delthyris granulosa, Cryphæus calliteles.	
20. Onondaga limestone,	Atrypa nasuta, Delthyris, two species, (new,) Asaphus seleneurus.	Wenlock limestone.
19. Oriskany sandstone,	Atrypa elongata, Delthyris arenosa; other large bivalves.	
18. Sandstone of Clarksville, Helderberg,	A large Orthoceras, Pterinea, (bilobite,) Calymene platys.	
17. Limestone of Clarksville,	Pileopsis tubifer.	
16. Sandstone,	Fucoides cauda-galli.	
15. Blue limestone,	Delthyris, (new.)	
14. Shaly limestone, Catskill creek,	Trilobites, (two new genera,) Delthyris macropleura, Pileopsis? (ventricore,) Atrypa, (two species,) Strophomena costellata.	
13. 2d Pentamerus limestone,	Pentamerus (Atrypa) galeatus, Atrypa lacunosa.	
12. Water limestone,	Tentaculites annulatus, Delthris, (new,) Orthis, (new,) various univalves unnamed, Cytherina, a large species.	

11. Gypseous shales,	Eurypterus remipes.	Wenlock shale.
10. Lockport limestone,	Catenipora, (new.)	
9. Rochester shale,	Asaphus limulurus, Platynotus, Trimerus delphinocephalus, Orthis elegantula, Strophomena transversalis, Caryocrinus.	
8. 1st Pentamerus limestone,	Pentamerus oblongus.	Caradoc sandstone.
7. Green slate and iron ore,	Agnostus latus, Strophomena corrugata, Tentaculites parvus.	
Top stratum.	Dictuolites Beckii.	
6. Niagara sandstone,	Fucoides Harlani, Lingula cornea.	
5. Olive sandstone and shale of Salmon river,	Pterinea carinata, Cyrtolites ornatus.	
4. Black slate,	Triarthrus Beckii, Graptolites or Fucoides dentatus.	
4. Trenton limestone,	Orthis testudinaria, O. callactis, Strophomena sericea, S. deltoidea, Calymene Blumenbachii, C. micropleura, Cryptolithus, Isotelus.	
3. Sparry limestone,	Fucoides demissus.	
2. Mohawk limestone,	Orthostoma communis.	
1. Calciferous and Potsdam sandstone,	Lingula cuneata.	
Hudson slates,	Graptolites, (Fucoides serra.)	

Species common to the Silurian rocks of Wales and the United States.

LUDLOW ROCKS.

Shells.

Cyrtoceras (Phragmoceras) giganteum,
Orthoceras pyriforme,
Bellerophron expansus,
Orthis orbicularis.

WENLOCK LIMESTONE.

Corals.	*Shells.*	*Trilobites.*
Cyathophyllum ceratites,	Tentaculites annulatus,	Calymene bufo,
helianthoides,	Strophomena euglypha,	(C. macrophthalma,)
turbinatum,	rugosa,	Asaphus limulurus.*
dianthus,	(Leptæna depressa, Sow.)	
Catenipora escharoides,	Pentamerus galeatus,	
Favosites fibrosa,	(Atrypa galeata, Dalm.)	
spongites,	Atrypa prisca,	
gothlandica.	(affinis, Sow.)	
	aspera,	
	lacunosa,	
	tenuistriata,	
	bidentata,	

* This appears to be the same with Murchison's A. longicaudatus, and is very distinct from the true caudatus, which has not I believe been found in New York; I have received from Dr. William Fleming, of Manchester, fine specimens of the latter in limestone, from Dudley. The former is common in the Rochester shales, and I have not seen it from any other formation. I also received from Dr. Fleming a specimen of A. limulurus, from Dudley.

WENLOCK SHALE.

Shells.	*Trilobite.*
Strophomena transversalis,	Asaphus limulurus,
(Leptæna, Sow.)	(Wetherilli, Green,)
Orthis elegantula,	(longicaudatus, Murch.)
(canalis, Sow.)	
hybrida,	
Delthyris lineatus.	

CARADOC SANDSTONE.

Shells.	*Trilobites.*
Strophomena alternata,	Cryptolithus tessellatus,*
sericea,	(Trinucleus caractaci, Murch.)
(Leptæna, Sow.)	Calymene micropleura,
Orthis testudinaria,	(Asaphus micropleurus, Green,)
callactis,	(Calymene punctata, Murch.)
flabellulum,	
Bellerophon acutus.	

Observations on the Plastic Clay.

There appears to be some difference of opinion respecting the relative position of this formation in the United States; by some geologists it is included in the secondary or cretaceous series, and by others in the lower tertiary, corresponding in position to the plastic clay of England. I have examined specimens from both countries, and the only difference I can perceive, is the more unctuous or glossy appearance of the English specimens. If of the same age, it is remarkable that a tertiary deposit should extend such a distance, and preserve its mineral character and its variegated appearance so perfectly as it does, or rather that the conditions for its deposition were so much the same in both countries in the same era. But this resemblance will not alone establish the relationship of the American with the plastic clay of Europe, and fossils we have none, whereby to institute a comparison. In Maryland and Virginia the lower fossiliferous tertiary rests either on the primary or cretaceous rocks, and has never been found re-

* Mr. Murchison thinks his species different from the tessellatus, in consequence of having long spinous processes to the buckler; but in this respect there is no difference between specimens in Wales and at Glenn's Falls, in New York, where I found them abundantly. The original specimens examined by my friend Dr. Green, were very imperfect, which accounts for the incomplete description of that accurate observer. I cannot omit to pay a passing tribute of praise to the zeal, industry and talent, which have put us in possession of a monograph of the trilobites, illustrated by models, that have greatly facilitated the labors of geologists, and stimulated inquiry into the history of Transition remains.

posing on a stratum similar to that termed plastic clay, whilst this latter is found at a short distance, towards the primary boundary. I do not say that it may not occur beneath the fossiliferous beds of the lower tertiary, although it has never been found in this relative position, but in the vicinity of Piscataway, Maryland, it reposes on the latter strata, and forms the hills around, whilst the tertiary fossils are found in the beds of creeks and bottoms of ravines. This clay is precisely similar to that around Baltimore, but unfortunately I could not find the lignite stratum, which characterizes the plastic clay in so many places, over a great extent of its course throughout the Union. But as that is a thin stratum, its absence must be expected in many localities of this formation. The evidence then, so far, is in favor of the opinion that this clay *overlies* the fossiliferous strata of the lower tertiary, and, therefore, does not exactly correspond in position to the plastic clay of England which underlies the beds of marine shells of the eocene period; still, they all belong to one era, and appear to have been deposited in estuaries or in fresh water in the beds of rivers near the sea. These remarks are made to call the attention of the state geologists to this subject, and it is hoped the question will soon be determined.

Observations on the Genus Gnathodon, with description of a new species.

Until recently, but a single species of this interesting genus was known to naturalists, the G. cuneata, (Gray,) an inhabitant of the estuaries of the Gulf of Mexico, and occurring in the upper tertiary formation in the bank of the Potomac river in Maryland, and on the Neuse river, North Carolina. The second species described, was found in the high bank at Yorktown, Virginia, and is only known as a fossil. The third, which I now describe, is a recent species from Florida, which I owe to the kindness of Dr. Forman of Baltimore. The three species are very distinct, and the differences may be briefly stated in the following characters.

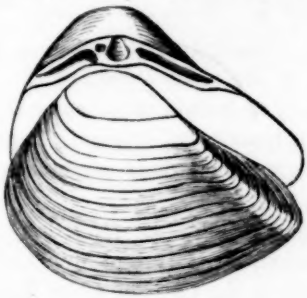
1. *G. cuneata.* Anterior and posterior lateral teeth arched, the latter being more than twice the length of the former.

2. *G. Grayi,* (fossil.) Anterior tooth not greatly shorter than the posterior; both nearly straight.

3. *G. flexuosa.* Lateral teeth not greatly differing in length, both much shorter than in the preceding species, and rectilinear. It is a smaller species than the others.

Gnathodon flexuosa.

Shell triangular, rather thick, posterior extremity subrostrated; umbonial slope obtusely carinated; lateral teeth short and straight.



Observations.—I have seen only a few water-worn valves of this species, which have probably been found on the sea beach, but they are evidently recent. It will be interesting to know what estuaries in Florida contain this Gnathodon, and whether it accompanies the G. cuneata. The carinated umbonial slope is a character which widely separates it from its congeners.

ART. XIV.—*Abstract of the Proceedings of the Ninth Meeting of the British Association for the Advancement of Science.*

THE ninth meeting of this scientific association was held at Birmingham, during the week commencing on the 26th of August, 1839. From the extensive report of the proceedings, published in the London *Athenæum*, Nos. 618—621, we give the following abstract.

The total number of tickets issued at Birmingham was 1438. The finances of the association are prosperous. Its permanent property consists of £5500 in the three per cent. consols; and books valued at £1094 10*s*.

At the General Meeting on the evening of August 26, Rev. Vernon Harcourt, President of the Association, delivered an eloquent address, in the course of which he gave an elaborate vindication of the claims of Cavendish to the scientific discoveries which have been usually attributed to him, and closed with a series of appropriate and impressive remarks on the accordance of science with Revelation.

The Marquis of Bredalbane was chosen President for the ensuing year. The next meeting will be at Glasgow, commencing on the 17th of September, 1840.

Section A. *Mathematics and Physics.*

Prof. Whewell, President of the Section, in a brief address, observed that one of the chief objects of the association was to grant sums of money to individuals or committees engaged in the pursuit of particular branches of science. Reports were then read concerning the progress of various committees in the duties assigned to them, as follows.

1. On a grant of £200, for the reduction, under the supervision of Sir J. Herschel, Mr. Airy, and Mr. Henderson, of the stars observed by Lacaille at the Cape of Good Hope, and recorded in his *Cœlum Australe Stelliferum;* the committee reported "that considerable progress has been made in the reduction of the stars in Lacaille's Cœlum Australe Stelliferum; and that, although only a small portion of the money appropriated, has been actually expended, nearly the whole will probably be required, during the ensuing year, to complete the work."

2. On a grant of £50 to defray expenses which might arise in the course of an inquiry, committed to Sir J. Herschel, Prof. Whewell, and Mr. Baily, concerning a *revision of the nomenclature of the stars* and a new distribution of the constellations; it was reported, "that some progress has been made in reforming the nomenclature of the northern constellations; and that the stars in the southern have been commenced laying down on a planisphere, according to their observed actual magnitudes, for the purpose of grouping them in a more convenient and advantageous manner. No expense has been incurred in this inquiry, but the committee are desirous that the grant should be continued for another year."

3. On a grant of £500 *for the reduction of the stars in the Histoire Céleste*, under the superintendence of Mr. Baily, Mr. Airy, and Dr. Robinson; it was reported, "that the reduction of the stars in the *Histoire Céleste* has been commenced, and already 13,000 stars have been reduced, at an expense of about £170. It is presumed that the greater part, if not the whole, of the remainder may be completed in the course of the ensuing year; and it is, therefore, expedient that the grant of money should be continued."

4. On a grant of £500, made for the purpose of *extending the Catalogue of Stars* of the Royal Astronomical Society, under the direction of Mr. Baily, Mr. Airy, and Dr. Robinson; it was reported, that about one half of the computations concerned in the extension of the Astronomical Society's Catalogue of Stars are completed, and about £180 has been expended. The whole of the remainder of the grant will probably be required within a year.

5. On a grant of £100 for the reduction, under the supervision of Sir John Herschel, of meteorological observations made at the equinoxes and solstices; it was reported, that owing to various causes, the execution of this commission had hitherto been impracticable, but it was hoped that the business might be accomplished before the next meeting.

6. On the resolution of August, 1838, requesting Sir J. Herschel and Mr. Baily to make application to the government for increase in the instrumental power of the Royal Observatory at the Cape of Good Hope, and the addition of at least one assistant to that establishment; it was reported, that application had been made, and the wishes of the association promptly and liberally complied with by the government.

7. Regarding the *Report on American Meteorology*, Pres. A. D. Bache of Philadelphia, stated to the meeting by letter, that the pressure of public duties and other causes, had thus far rendered its completion impracticable, but that he hoped to lay it before the next meeting.

8. Respecting the two *series of Hourly Meteorological Observations* kept in Scotland, Sir D. Brewster made a report, of which the following is a part: "Having fixed upon Inverness and Kingussie as two suitable stations for carrying on the two series of hourly observations which I undertook to establish and superintend for the British Association, I was fortunate in being able to prevail upon the Rev. Mr. Rutherford, of Kingussie, and Mr. Thomas Mackenzie, teacher of Raining's school, Inverness, to carry on these observations. The instruments which were necessary for this purpose, were made by Mr. Adie of Edinburgh, under the superintendence of Prof. Forbes, and the observations commenced on the 1st of November, 1838, the beginning of the meteorological year, or the first of the group of winter months. I directed the two observers to pay particular attention to the Au-

rora Borealis, and to record every phenomenon of this nature; and I have no doubt, from the lists already sent me, that this class of observations will be the most complete and valuable that have ever been made." Accompanying this report were tables of hourly observations of the barometer and thermometer (made at Kingussie, 700 or 800 feet above sea level, by Mr. Rutherford) during the 27th, 28th, 29th, and part of the 30th of November, 1838; the barometer having gradually sunk down to the lowest, 27.200, on the 29th at 3 P. M., and risen again rapidly to its usual height after 9 A. M. of the 30th. There were also accounts of three occurrences of the Aurora Borealis, viz. on the 13th and 17th of November and 14th of December, 1838.

A paper was read *On the best positions of three magnets, in reference to their mutual action*, by Rev. H. Lloyd. It is a problem of much importance, in the arrangement of a magnetical observatory, to determine the relative position of the magnetical instruments in such a manner, that their mutual action may be either absolutely null, or at least readily calculable. Such the author stated to be the object of the present investigation. The problem may be reduced to this; to determine the position of the three magnets A, B, and C, in such a manner, that the resultant actions exerted upon A and B, respectively, by the other two, shall lie in the magnetic meridian. The solution of this problem was shown to be contained in two equations, which may, of course, be satisfied by means of two unknown angles; so that when we have a greater number of undetermined quantities, some of them remain arbitrary, and the conditions may be fulfilled in various ways. In reply to a question from the President, Mr. Lloyd briefly explained the arrangement of the *portable observatory*, adopted by Capt. J. Ross, in his preparations for the Antarctic Expedition. It is so constructed as to form either *three* small separate rooms, or *one* large one. The former arrangement is desirable at places where the dip is nearly 90°, and where, consequently, the horizontal directive force is very small, and the disturbing action of the magnets on one another, relatively great. The parts are connected with copper fastenings; and the whole is so arranged, as to occupy a very small bulk when in pieces, and to be capable of being put together with quickness and security.

New Photometer. Prof. Daubeny exhibited the model of an apparatus, by means of which, in a more complete condition, he

hoped to obtain a numerical estimate of the intensity of solar light at different periods of day, and in different parts of the globe. It consisted of a sheet of photogenic paper, moderately sensible, rolled round a cylinder, which by means of machinery, would uncoil at a given rate, so as to expose to the direct action of the solar rays, for the space of an hour, a strip of the whole length of the sheet, and of about an inch in diameter. Between the paper and the light was to be interposed a vessel, with plane surfaces of glass at top and bottom, and in breadth corresponding to that of the strip of paper presented. This vessel, being wedge-shaped, was fitted to contain a body of fluid of gradually increasing thickness, so that, if calculated to absorb light, the proportion intercepted, would augment in gradually increasing proportion from one extremity of the vessel to the other. Hence it was presumed that the discoloration arising from the action of light would proceed along the surface of the paper to a greater or less extent, according as the intensity of the sun's light was such as enabled it to penetrate through a greater or less thickness of the fluid employed. In order to register the results, nothing more was required than to measure, each evening, by means of a scale, how many degrees the discoloration had proceeded along the surface of the paper exposed to light, during each successive hour of the preceding day. To render the instrument self-registering, some contrivance for placing the paper always in a similar position with reference to the sun, must, of course, be superadded. The object of this contrivance differed from that aimed at, by Sir J. Herschel, in his *Actinometer*, which merely measures the solar intensity at the moment of observation; whereas, this is intended as a measure of the aggregate effect of the intensity at the period, be it long or short, during which the paper was submitted to its influence. The interposition of an absorbing fluid has at least this advantage, that it enables the observer to estimate the relative intensity by marking the point at which the paper ceases to be discolored, of which the eye is able to judge more exactly, than of the relative darkness of shade which might be produced on paper exposed unprotected to light of different degrees of brilliancy.

Mr. Talbot offered some remarks on Daguerre's *photogenic process*.* M. Arago had stated to the Institute that the sciences

* See this Jour. 37; 374.

of Optics and Chemistry united, were insufficient in their present state, to give any plausible explanation of this delicate and complicated process. If M. Arago, who had the advantage of being for six months acquainted with the secret, and therefore of considering its nature in all points of view, was of this opinion, it seemed as if a call were made on all the cultivators of science to use their united endeavors, by the accumulation of new facts and arguments, to penetrate into the real nature of these mysterious phenomena. For this reason he would offer a small contribution of new observations, which might perhaps be of service in the elucidation of this new branch of science. The first part of Daguerre's process consists in exposing a silver plate to the vapor of iodine, by which it becomes covered with a stratum of iodide of silver, which is sensitive to light. Mr. T. stated that this fact had been known to him for some time, and that it formed the basis of one of the most curious of optical phenomena, which as it did not appear to have been observed by Daguerre, he would here describe. Place a particle of iodine, of the size of a pin's head, on a plate of silver, or on a piece of silver leaf spread on glass. Warm it gently, and you will shortly see the particle surrounded with colored rings, whose tints resemble those of Newton's rings. Now, if these colored rings are brought into the light, a most singular phenomenon occurs; for the rings prove to be sensitive to the light, and their colors change, and in a short time their original appearance is quite gone, and a new set of colors occupy their places. These new colors are altogether unusual ones; they do not resemble any thing in Newton's scale, but seem to have a system of their own. For instance, the two first colors are *deep olive green, and deep blue inclining to black*, which is quite unlike the commencement in Newton's scale. It will be understood that the outermost ring is here accounted the first, being due to the thinnest stratum of iodide of silver, farthest from the central particle. The number of rings visible is sometimes considerable. In the centre of all, the silver leaf becomes white and semi-transparent like ivory. This white spot, when heated, turns yellow, again recovering its whiteness when cold: from which it is inferred to consist of iodide of silver in a perfect state. The colored rings seem to consist of iodide of silver in various stages of development. They have a further singular property, which, however, has not been sufficiently examined

into. It is as follows: it is well known that gold leaf transmits a bluish green light; but no other metal has been described as possessing colored transparency. These rings of iodide of silver, however, possess it, being slightly transparent, and transmitting light of different colors. In order to see this, a small portion of the film should be isolated, which is best done by viewing it through a microscope. Mr. T. said that he had considered the possibility of applying a silver plate thus combined with iodine, to the purpose of photogenic drawing, but he had laid it aside as insufficient for that purpose, because its sensitiveness appeared to be much inferior to that of paper spread with chloride of silver, and therefore in an equal time it takes a much feebler impression. Now, however, M. Daguerre has disclosed the remarkable fact that this feeble impression can be increased, brought out and strengthened, subsequently, by exposing the plate to the vapor of mercury. Another experiment was then related, in which a particle of iodine was caused to diffuse its vapor over a surface of mercury. In order to this, a copper plate was spread over with nitrate of mercury, and then rubbed very bright and placed in a closed box along with a small cup containing iodine. The result was, a formation of colored rings of the greatest splendor and of large size. But they did not appear to be in any degree, sensitive to light. The next point of Daguerre's process is, the exposure of the picture to the vapor of mercury, and this is by far the most enigmatical part of the whole process. For he states that if you wish to view the picture in the usual manner, i. e. vertically, you must hold the plate inclined to the vapor at an angle of 45°, and *vice versâ*. Now this is altogether extraordinary; for who ever heard of masses of vapor having determinate *sides*, so as to be capable of being presented to an object at a given angle? From the hasty consideration which he had been able to give to it, his first impression was, that this fact bore a certain analogy to some others which he would mention. If a piece of silver leaf is exposed to the vapor of iodine, however uniform the tension of the vapor, it does not combine uniformly with the metal, but the combination commences at the edge of the leaf and spreads inwards, as is manifested by the formation of successive bands of color parallel to the edge. This is not peculiar to silver and iodine, but occurs when other metals are exposed to other vapors, not always with entire regularity, but it displays a ten-

dency to combine in that way. A possible explanation is that this is due to the powerful electrical effect which the sharp edges and points of bodies are known to possess: in fact, that electricity is either the cause or the attending consequence of the combination of vapor with a metallic body. Again, if a minute particle of iodine is laid on a steel plate, it liquefies, forming an iodide of iron, and a dew spreads around the central point. Now, if this dew is examined with a good microscope, its globules are seen not to be arranged casually, but in straight lines along the edges of the minute striæ or scratches which the microscope detects even on polished surfaces. This is another proof how vapor is attracted by sharp edges, for the sides of those striæ are such. In regard to the sensitiveness of his photogenic paper, Mr. T. stated, that it will take an impression from a common argand lamp in one minute, which is visible though weak. In ten minutes the impression is a pretty strong one. In full daylight the effect is nearly instantaneous.

Mr. Scott Russell brought up the Report by Sir John Robinson and himself, the committee on *Waves*. Since the last meeting the committee had continued their researches, and had in each department confirmed or corrected the results formerly obtained by them, and had also extended their acquaintance with several interesting phenomena. The first object of their attention was the determination of the nature and laws of certain kinds of waves. Of these, the most important species was that called by Mr. Russell, the Great Solitary Wave, or the Primary Wave of Translation: the second, was the Oscillatory Wave or secondary species. The recent researches, while they had confirmed and extended the observations of preceding years, have in no respect altered the views formerly stated by the committee. The form of the wave is that to which the name *hemicycloid* has been given; its velocity is that due to half the depth of the fluid, reckoned from the top of the wave to the centre of gravity of the section, where the depth of the channel is not uniform. The motion of the particles, is a motion of permanent translation in the direction of the motion of the wave, through a space equal to double the wave's height; the particles of the water perfectly at rest before the approach of the wave, are lifted up, translated forwards, and deposited perfectly at rest in their new locations,—the translation taking place equally throughout the whole depth of the fluid.

Prof. Whewell communicated a letter from T. G. Bunt, Esq., of Bristol, showing the progress made in the Tide-calculations which had been assigned to the former. Elaborate and delicate observations on the tides have for some time been carried on at this place, but the details are too extensive for insertion here.

On the use of Mica in polarizing light, by Professor Forbes. The author explained the method of preparing mica used by him since 1836 for the polarization of heat and light. The mica is exposed for a short time to an intense heat in an open fire, by which the laminæ are so subdivided, that a pellicle of extreme thinness contains a sufficient number of reflecting surfaces, to polarize very completely the light or heat transmitted through it at a certain degree of obliquity. Being struck by the resemblance to metallic lustre, which the mica thus acquires, he also examined in 1836 some of its leading properties with regard to light, and found 1st, that the light reflected from a plate of mica so prepared (which light is very intense,) is but feebly polarized in the plane of incidence; and 2d, that the reflection so far resembles that at metallic surfaces, that when plane-polarized light is reflected from it, the plane of reflection being inclined to that of primitive polarization, the light is found to be elliptically polarized.—Prof. Lloyd observed, that, simple as this discovery might appear to those not conversant with this intricate subject, yet he considered it as highly important, not only as furnishing a method of polarizing light elliptically and circularly, more simple than any previously in use, but as it would also essentially aid the researches of those engaged in perfecting the theory of this interesting branch of physical optics; indeed, did time permit, he thought he could show that it furnished a clue at least to the solution of some of the difficulties which had hitherto opposed the progress of inquiry. In polarizing light elliptically or circularly, it was well known that the condition to be obtained is, that two rays should encounter one another in different phases, or, to speak the conventional language, of which one is accelerated by a half or some proportional part of a wave, while the other is either similarly or dissimilarly retarded. In this case, this condition is obtained, and with respect to a greater quantity of rays than in other processes, for those rays which, after being reflected at the first surface of those very thin laminæ of mica which they met, were afterwards encountered by those rays which passed into the

laminæ, were reflected at the hinder surface, and came out again after refraction at the first. Now it is obvious that the necessary conditions of acceleration and retardation of the rays could be thus obtained; and the vast multitude of exceedingly thin laminæ which are produced in the plate of mica, by the process of Prof. Forbes, far surpassed any thing which, by the most delicate mechanical operations we can hope to obtain. These researches are also of the utmost importance as tending to throw light on the internal structure of metals. Young, with his usual sagacity long since conjectured, from the well known fact that very thin leaves of gold transmit greenish light with almost unimpaired regularity, that the surfaces of all metallic plates consist of very thin laminæ, pervious to light, and that the phenomena of their polarizing influences depended on this. Fresnel followed out this conception, and traced mathematically the mode in which the polarization would take place. The present researches not only confirm these views, which were heretofore only conjectural, but actually show, how under certain conditions, elliptic and circular polarization could be obtained by a method similar to that producing ordinary polarization.

Mr. J. F. Goddard described an apparatus which he had constructed, by means of which he could exhibit in the Oxyhydrogen microscope, all the beautiful phenomena of polarized light.

Mr. Addison presented tables of *meteorological observations made at Great Malvern*, in Worcestershire, from 1835 to 1838 inclusive. From these tables it appears, that the mean temperature of Malvern is 47.7°; the mean barometrical pressure is 29.386 in., and the mean dew point at 9 A. M., is 43.7°. The range of temperature during the four years, is from 9° on the 20th of January, 1838, to 84° on the 5th of July, 1836. The range of the barometer is from 28.010 in., November 29, 1838, to 30.228, October 14, 1837.

Mr. Julius Jeffreys offered a few observations on *the meteorology of elevated regions*. In 1824 he traversed through a space of 200 miles the higher range of mountains in the protected States in the Himalayas, for the purpose of conducting inquiries into the meteorology of those regions, and the character of the climate in a medical point of view. His observations were made during six months, upon mountain heights and in their subjacent valleys, from an elevation of 16,300 feet down to 4,000; and of

valleys, from one nearly 14,000 feet high to one of 3,000 feet. The diurnal variations of temperature on mountain heights, he found to be small, rarely more than 12°, and sometimes only 4° or 5° ; while in the valleys they were very great, so that commonly the minimum of the night was 30° and sometimes 40° below the maximum of the day. The hygrometric condition of the air corroborated certain of Prof. Daniell's views. The medical application of these inquiries had induced Mr. J. to publish an essay, to show among other points, that a removal of a considerable portion of the atmospheric pressure from the surface of the human body, must conduce to the restoration of the function of the skin, when exhausted by excess of duty in a tropical climate, and sympathy with a debilitated liver.

Col. Sykes offered some statements on *Certain Meteorological phenomena in the Ghâts of Western India.* The correctness of the assertion of the annual fall of many feet of rain in certain localities of India, having been doubted by many persons, Col. S. had procured the official meteorological records for 1834, kept by order of the government of Bombay, at the convalescent station of Mahabuleshwar. The observations were taken by Dr. Murray, the medical officer in charge at that station. The place is in N. lat. 17° 58′ 53″, E. long. 73° 29′ 50″, near the western scarp of the Ghâts, or mountain chain extending from Surat to Cape Comorin. Its elevation is about 4,500 feet. The temperature of a spring is 65.5° F. and the mean temperature of the air is nearly the same. There is some forest along the Ghâts, but in belts and patches, so that the wood can have little meteorological effect. From the tables it appears, that the mean temperature of 1834 was 67.3° F. ; that of the hottest month (April,) 74.4° ; that of the coldest month, (Dec.) 62.3°. The fall of rain was prodigious, amounting to 25 feet 2 inches ; and this enormous mass of water fell almost entirely in the months of June, July, August and September. The excessive fall of rain seems not incompatible with health, for the military detachment stationed at Mahabuleshwar is not characterized by any unusual sickness.

Mr. Follet Osler gave an account of the *indications of his anemometer as observed at Birmingham.* He made a detailed statement of the changes of the wind about the 19th of November, 1838, observed at Plymouth and at Birmingham, and concluded with some remarks on the great storm of the 6th and 7th of Jan-

uary, 1838, which committed such dreadful ravages in England. A careful analysis of the information I have collected, leads me, (said Mr. O.) to the opinion that this was a small, but violent rotatory storm, moving forward at the rate of 30 or 35 miles per hour. The diameter of the rotating portion, I am not prepared to give, nor do I consider it at all certain that it could be ascertained, as it seems likely that the revolutions were not in contact with the earth. The tendency of this eddy, or violent whirling of the air, would of course, be to produce a vacuum in the centre. The air that forms the eddy being constantly thrown off in a slight degree spirally upwards, and dispersed on the upper portion of the atmosphere, the effect of this would be, to produce a strong current upwards. Now, supposing this large eddy to be perfectly stationary, there would be a rapid rush of air towards it from all sides, which would be drawn up and thrown off through this rotating circle, and dispersed with amazing rapidity above; but as it is moving on with great velocity, the air that is in the advance of the storm is not sensibly affected until the whirl is close upon it, while in the rear the motion of the air is greatly increased; first, by the tendency of the air to rush into the great vortex of the storm; and secondly, by the motion onward of the vortex itself. This vortex or revolving column would increase in size upwards, so as somewhat to resemble a funnel; it would, in fact, be similar in its shape and action to an immense water-spout; whether it was vertical or not is entirely a matter of conjecture, but I should consider it probable that it would incline in the direction that the storm was moving, namely, to the N. E., and that it was an upper current that carried it in that direction. The greatest intensity of the storm in England was evidently across Lancashire and Yorkshire. I therefore conceive that the nucleus of the hurricane passed in a N. E. direction over these two counties. Towards the sides, however, a little current set in a S. and even slightly in a S. E. direction, on the S. side of the vortex; and in a N. W. and W. direction on the N. side, as before stated; but the main rush is behind. Our anemometer shows that we first felt a fresh S. wind with a slight bearing of E. in it, which very shortly became more westerly, increasing considerably in violence. It then moved round to the S. W. and became quite a hurricane, and continued so, very violent at first, but decreasing in strength during the remainder of the day. At Plymouth it

commenced at S. W. and then very gradually moved round a little more westward. It was by careful examination of the records of these two instruments that I arrived at the view I ventured to take of this storm, and the evidence I have collected from various parts of the country concerning it, strongly confirms me in the opinion I have taken of it. Many violent storms followed in the wake of this extraordinary hurricane, but I have not attempted to investigate these, as the main storm would have thrown the atmosphere into so disturbed a state, that it would be very likely to produce minor eddies, gusts, &c.

Prof. Stevelly observed that so long ago as 1834, at the Edinburgh meeting, he read a paper in which he attempted to explain and account for, on well-established principles, the four leading meteorological phenomena,—cloud, rain, wind, and hail. He gave reasons for rejecting the vesicular hypothesis as to the constitution of cloud, chiefly because no causes were known to exist adequate to the production of vesicles, and capillary attraction would tend to prevent it; and adopting the view of solid spherics, he showed that mere diminution of size would be sufficient to account for their suspension, as even globules of platina could be so reduced in size and suspended in such a manner as to descend at any given velocity, however small; adding to this the fact that electrical atmospheres to the globules, by repelling the air on all sides from the spherule of water, would virtually enlarge the bulk, without adding to the weight of the drop, and thus aid the suspension. Next, as to the formation of cloud; when a portion of cloud was once formed in air, loaded with vapor in the elastic state, the instant effect was a diminution of tension, and a fall of temperature in that spot; air would then rush in on all sides, but air loaded with vapor, rushing into a void will form cloud; more cloud would, therefore, be formed, and the causes again put into operation for the formation of more, and this, (as he called it,) *secondary* formation of cloud, would go on with greater rapidity the more the air was loaded with vapor, and along whatever course the air so loaded by the growing of the cloud would advance; in the mean time, the air rushing in to fill up the comparative void, would establish, when the causes were strongly in operation, progressive whirls, such as those described by Mr. Redfield and Col. Reid, on the same principle that water while going on along a course, if let out by a hole in the bottom, forms

a whirlpool. The general correctness of this view was shown by the fact that Mr. Redfield's and Col. Reid's whirls were found to advance along the course of the gulf-stream, the warmth of which tended to load the air above it with vapor; and in the hurricane which did such damage to Charleston, the town was saved from destruction by the fact that the most violent part of the storm followed the bend of the river: the shipping was nearly destroyed. In this way was also to be accounted for, the perplexing fact that the storm was propagated against the course of the wind, as is well known also in summer thunder storms. These were the phenomena of dry storms. When much rain fell, the space above was left arid also by the descent of the water, while the air below was pushed out on all sides, thus very much modifying the current at the surface, increasing the force to leeward, and diminishing it to windward, causing sometimes the fearful and sultry calm preceding the thunder storm; the fall of temperature above, in consequence of the expansion of the air rushing in to fill the void, often froze into hail the rain-drops as they passed through, the surface of the boles of which would be clear ice; but, expanding as it formed the shell, the inner part would be opake and crystalline, because partly void. Mr. Espy, of Philadelphia, had a theory nearly the reverse of this: he conceived the heat given out by the vapor in passing to the state of cloud or rain, to be so abundant, as, by its rarefying influence to cause a rapidly ascending column or vortex, capable of producing most appalling effects; and the only step doubtful in this theory was the first,—for before the vapor can pass to the state of water, it must be robbed of this very latent heat by an external cause; but, grant this first step, and the rest of Mr. Espy's theory was almost a series of mathematical demonstrations.

A valuable paper was then read, "*on certain results* which he had recently arrived at, respecting the minimum thickness of the crust of the globe, which might be consistent with the observed phenomena of Precession and Nutation, assuming the earth to have been originally fluid," by Mr. W. Hopkins.

Mr. Smythies then communicated a general method of solving dynamical problems relating to the motion of free bodies, by means of differentiation and elimination of differentials without any integration, by which the result is obtained in a finite number of algebraical terms, when the equations of condition determining the motion are algebraically assigned.

Prof. Powell presented a report on *refractive indices*, containing the mean results of many series of observations for a considerable range of substances. The author made a few preliminary observations on the nature of the inquiry, especially with reference to some points of dispute respecting the identification of certain rays of the spectrum, which had been discussed by Sir D. Brewster and himself.

Mr. Nasmyth exhibited a Plate-glass pneumatic speculum, of his invention. The glass was three feet three inches in diameter, and three sixteenths of an inch thick. It was placed on a concave cast-iron bed and fastened in with bees-wax, which rendered the apparatus air-tight.

On a new case of interference of light, by Prof. Powell. The author observed that when a prism of one substance was opposed to another, slightly differing in dispersive power, (as plate glass and oil of sassafras,) so as to produce a partial achromatism, *in the colored edges*, which appeared on either side of the white image of a narrow line of light, when viewed through a small telescope, there were formed *dark bands;* about four or five being visible on each edge, parallel to the line of light. The explanation is easy, when we consider that of the parallel pencil of each primary ray which enters the eye, (in breadth equal to the aperture of the pupil,) the rays which have traversed greater thicknesses of the first prism, traverse less thicknesses of the second; and thus have their retardations so nearly compensated, as to be in a condition to interfere and produce the dark bands observed. In the same manner Prof. P. explained the analogous optical phenomena observed by Sir D. Brewster, and stated at previous meetings of the Association.

Dr. Andrew Ure offered some account of his mode of measuring, by means of photogenic paper, diffuse daylight comparatively at any time and place. He also recounted a series of experiments which he had made to determine the fluency or viscidity of different liquids at the same temperature, and of the same liquids at different temperatures.

Mr. W. J. Frodsham exhibited and described his *improved compound pendulum.* It is an ordinary pendulum, with a steel rod, over which Mr. F. slips a zinc tube, which passes through a brass bob, and rests on the adjusting screw at the lower end of the rod, the bob being fastened at the centre by two connecting rods of

steel to the tube, at the point at which the expansion of the tube is the same as that of the rod; so that, as the steel rod expands downwards, and is lengthened by heat, the zinc tube expands upwards in the same degree; and therefore, if the lengths of the rod and the tube be rightly proportioned, the pendulum may be regarded as of invariable length. Some other additional apparatus is devised in order to the greater perfection of this pendulum, but the description is too long for this place.

The Secretary read the report of the Committee, consisting of Sir J. Herschel, Mr. Whewell, Mr. Peacock, and Prof. Lloyd, appointed to represent to government the resolutions adopted by the Association in August, 1838, recommending that *Magnetic Observatories* be established in various parts of the British dominions, and that a naval expedition be fitted out for the purpose of determining, by observations, the magnetic direction and intensity, in high southern latitudes, between the meridians of New Holland and Cape Horn. It is well known that this application was eminently successful; that the Antarctic Expedition sailed in the summer of 1839, and that efficient measures have been taken to secure a magnificent system of magnetic observations.

Prof. Powell made a communication on *certain points in the wave-theory as connected with Elliptic polarization.* Its object was to set forth a general statement of some material conditions which involve in a common relation the theory of dispersion, of the wave surface and of elliptic polarization.

Mr. E. Hodgkinson gave an account of experiments made by order of the Association on the *temperature of the Earth* in the deep mines of Lancashire and Cheshire. Satisfactory results appear not to have been yet fully attained, and the experiments are to be continued.

Prof. Forbes submitted a report of observations made by order of the Association on the *temperature of the Earth* at different depths near Edinburgh. These observations were commenced in February, 1837, and have been regularly continued since. The object was to ascertain the conducting power for heat, of different soils, and the measure of the sun's influence at different depths under similar external circumstances. At each station four thermometers were sunk to the depths of 3, 6, 12, and 24 French feet respectively, the tubes of each being carried above the surface so as to be conveniently exposed side by side. The

readings were made every week, and corrected for the temperature of the stem and scale, and the results were projected in the form of curves. Among other valuable results, it is deduced from the observations of 1838, that the oscillations of annual temperature would be virtually extinguished at a depth of 49 feet in traf tufa, 62 feet in incoherent sand, or 91 feet in compact sandstone.

Mr. Snow Harris reported on the progress of the *meteorological observations made by order of the Association at Plymouth*, with the barometer and thermometer. The following general results were mentioned. The mean height of the barometer at the Plymouth dock-yard, 60 feet above sea level, at 60° F. was from the latest results, 29.8967 in. It occurred in the mean hourly progression four times in the day, viz. at 2h. 20m. and 8h. 10m. A. M.; and at 12h. 30m. and 6h. 15m. P. M., at which times the waves crossed the mean pressure line. The hours of greatest pressure were 10 A. M. and 9 P. M.—of least pressure, 5 A. M. and 3 P. M. With reference to the *influence of the moon on the barometer*, Mr. H. had reduced about 4000 of the observations, so as to show the pressure for the time of the moon's southing, and for each hour before and after; but he could not discover any differences which could be supposed to arise from the moon's influence.

Dr. Andrew Ure described *a new Calorimeter*, by which the heat disengaged in combustion may be exactly measured, and he gave, also, some introductory remarks on the nature of different coals. In these researches, which are still in progress, the first determination sought is the proportion of volatile and fixed matter afforded by any kind of fuel. This shows how far the coal is a flaming or gas coal, and what quantity of coke it can produce. The second point to be determined is the amount of sulphur contained in the coals, a matter of great importance, as regards their domestic use, their employment by the iron master and the manufacturer of gas. Dr. Ure's future researches are intended to embrace every variety of fuel, and the results will doubtless be highly important.

Prof. Stevelly communicated his *method of filling a barometer without the aid of an air-pump;* and of obtaining an invariable level of the surface of the mercury in the cistern. He heated the mercury as hot as it could be used, and filled the tube in the

common mode, to within half an inch of the top; then worked out, in the usual way, all air bubbles as perfectly as possible; filled up the tube to the top and inverted it in a cup of hot mercury, when it, of course, subsided in the upper part of the tube to the barometric height; he then placed his finger on the mouth of the tube under the mercury in the cup, and lifted it out; and still holding his finger tightly over the mouth of the tube, laid it flat on a table, when the mercury in the tube soon lay at the under side of the tube, leaving void the upper part along the length of the tube. On turning the table slowly round, still keeping the finger on its mouth, every particle of air was gathered up. He then placed the tube upright, with its mouth upwards, and placing a funnel of clean dry paper about the upper part, an assistant filled the funnel slowly with hot mercury, so as to cover the fingers. On slowly withdrawing the finger, the mercury went gently in, and displaced almost perfectly the atmospheric air which had gathered into the void space. By renewing the process which succeeded the previous washing of the air out of the tube, once or twice, a column of the utmost brilliancy was obtained. Dr. Robinson suggested the substitution of a piece of caoutchouc for the finger in this process, and it was found a decided advantage. The method of procuring an invariable surface in the cistern was equally simple. He proposed to divide the cistern into two compartments, by a diaphragm of sheet iron or glass brought to a sharp edge at top. Into one of these compartments the tube dips; in the other is placed a plunger of glass or cast iron, which can be raised or lowered by a slow screw movement. To prepare for observation, the plunger is first screwed down, by which it displaces the mercury in one compartment, and raises its surface in the other above the edge of the diaphragm; on raising it slowly again, the mercury drains off to the level of the edge of the diaphragm; thus at every observation, reducing the surface to a fixed level.

The following letter was communicated from Sir John Herschel, containing a most interesting communication respecting the action of the dissevered rays of light in the solar spectrum.

My Dear Sir,—May I take the liberty of requesting that you will mention to the Physical Section of the British Association a very remarkable property of the extreme red rays of the Prismatic

Spectrum, which I have been led to notice in the prosecution of my inquiries into the action of the spectrum on paper, rendered sensitive to the chemical rays by Mr. Talbot's process, or by others of my own devising.

The property in question is this:—that the extreme red rays, (such, I mean, as are insulated from the rest of the spectrum by a dark blue glass colored by cobalt, and which are not *seen* in the spectrum unless the eye be defended by such a glass from the glare of the other colors,) not only have no tendency to darken the prepared paper, but actually exert a contrary influence, and *preserve* the whiteness of paper on which they are received, when exposed at the same time to the action of a dispersed light sufficient of itself to produce a considerable impression. I have long suspected this to be the case, from phenomena observed in taking photographic copies of engravings; but having at length obtained demonstrative evidence of the fact, I think this may not be an improper opportunity to announce it.

When a slip of sensitive paper is exposed to a highly concentrated spectrum, a picture of it is rapidly impressed on the paper, not merely in *black*, but in *colors*, a fact which I ascertained nearly two months ago, and which observation of mine seems to have been alluded to (though in terms somewhat equivocal) by M. Arago, in his account of Daguerre's process. In order to understand what follows, it will be necessary to describe the colors so depicted. The red is tolerably vivid, but is rather of a brick color than of a pure prismatic red; and what is remarkable, its termination falls materially short of the *visible* termination of the spectrum. The green is of a sombre, metallic hue; the blue still more so, and rapidly passing into blackness. The yellow is deficient. The whole length of the chemical spectrum is not far short of double that of the luminous one, and at its more refrangible end a slight ruddy or pinkish hue begins to appear. The place of the extreme red, however, is marked by no color, thus justifying *so far* the expression which M. Arago is reported to have used in speaking of my experiments, "Le rayon rouge est seul sans action."

It is impossible in this climate to form a brilliant and condensed spectrum without a good deal of dispersed light in its confines; and this light, if the exposure of the paper be prolonged, acts, of course, on every part of its surface. The colored picture is formed,

therefore, on a ground not purely white, but rendered dusky over its whole extent, *with one remarkable exception*, viz. in that spot where the extreme red rays fall, the whiteness of which is preserved, and becomes gradually more and more strikingly apparent the longer the exposure and the greater the consequent general darkening of the paper.

The above is not the only singular property possessed by the extreme red rays. Their action on paper already discolored by the other rays is still more curious and extraordinary. When the spectrum is received on paper already discolored slightly by the violet and blue rays *only*, they produce, not a white, but a red impression, which, however, I am disposed to regard as only the commencement of a process of discoloration, which would be complete if prolonged sufficiently. For I have found that if instead of using a prism, a strong sunshine is transmitted through a combination of glasses carefully prepared, so as to transmit absolutely no ray but that definite red at the extreme of refrangibility, a paper previously darkened by exposure under a *green* glass has its color heightened from a sombre neutral tint to a bright red; and a specimen of paper rendered almost completely black by exposure to daylight, when exposed for some time under the same glass, assumed a rich purple hue, the rationale of which effect I am disposed to believe consists in a very slow and gradual destruction, or stripping off as it were, of layers of color deposited or generated by the other rays, the action being quicker on the tints produced by the more refrangible rays in proportion to their refrangibilities.

It seems to me evident that a vast field is thus opened to further inquiries. A deoxydizing power has been attributed to the red rays of the spectrum, on the strength of the curious experiments of Wollaston on the discoloration of tincture of guaiacum, which ought to be repeated; but in the sensitive papers, and still more in Daguerre's marvellous ioduretted silver, we have re-agents so delicate and manageable, that every thing may be expected from their application. J. F. W. Herschel.

Slough, August 28, 1839.

On the effects of lightning in three of Her Majesty's ships, by Mr. Snow Harris. Mr. H. showed from the facts which he had collected, that were the masts of ships made perfectly good con-

ductors of electricity, and freely connected by efficient conductors with the sea, the electrical agency would have an unlimited and easy source of diffusion in all directions, and hence the ship would be safe from the moment the flash struck the mast head. From his inquiries it appeared that in 100 cases of ships in the British Navy struck by lightning, the number struck on the main-mast were to those struck on the fore-mast as 2 : 1 ; to those struck on the mizen-mast, as 10 : 1 ; to those struck on the bowsprit, as 50 : 1. About one ship in six is set on fire in some part of the hull, sails or rigging. In one half the cases some of the crew were either killed or wounded. In the 100 cases alluded to, 62 seamen were killed, and about 114 wounded. These are exclusive of one case of a frigate, in which nearly all the crew perished, and of 12 cases in which the numbers killed or wounded were set down in the accounts given as *several* or *many*. In these 100 cases, there were damaged or destroyed 93 lower masts, principally of line-of-battle ships and frigates, 83 topmasts, and 60 topgallant-masts.

A notice was read, from Dr. Robinson, on the determination of the arc of longitude between the observatories of Armagh and Dublin. In September, 1838, Mr. Dent, by means of twelve chronometers, determined the longitude of Dublin to be +25m. 21.08s., longitude of Armagh +26m. 35.44s. Subsequently, by means of rocket-signals, Dr. R. found the difference between Armagh and Dublin to be 1m. 14.258s. or .1s. less than the chronometrical determination.

The *Longitude of New York City Hall* was determined by Mr. E. J. Dent, by means of chronometers sent out by the British Queen, in July, 1839, to be +4h. 56m. 3.55s. which varies less than 3s. from the previously received determination. (See this Journal, vol. xxxvii, p. 400.)

Prof. Whewell made some remarks on Dr. Wollaston's argument on the question of the infinite divisibility of matter, drawn from the finite extent of the atmosphere. Dr. W. imagined that if the extent of the earth's atmosphere be finite, air must consist of indivisible atoms, since he assumed that the only way in which we can conceive an upper surface of the atmosphere, is by supposing an upper stratum of atoms, the weight of which, acting downwards, is balanced by the repulsive force of the inferior strata acting upwards. Prof. W. contended that such a

mode of conception was arbitrary, and the argument founded upon it, baseless; for if we investigate the relation between the height of any point in the atmosphere, and the density of the air at that point, on the supposition that the compressing force is as the *n*th power of the density, we find that the density vanishes at a finite height whenever *n* is greater than unity. Therefore, though the atmosphere do not consist of indivisible particles, it will still have a finite surface. In fact, the finite surface of the atmosphere no more proves the atomic constitution of air, than the finite surface of water, in a vessel, proves the atomic constitution of water.

Section B. *Chemistry and Mineralogy.*

Prof. Graham, President of the Section, opened the meeting with some observations on the recent progress of chemistry, which, in his view, is advancing with unprecedented rapidity, both in its theory and its applications. The organic department is the most productive, and at present engrosses the attention of chemists. In this department he would allude to what seemed to him its two great features. 1. The happy generalization of Dumas,—*the law of substitutions*, which had been the clue to so many discoveries. He first applied it to the action of chlorine upon organic compounds, finding that when chlorine acts upon those bodies, for every atom of hydrogen abstracted in the form of hydrochloric acid, an atom of chlorine is left in its place. The same doctrine has been successfully applied to the action of oxygen and other elements on the same bodies. Thus, in the oxidation of alcohol in the acetous fermentation, hydrogen is withdrawn in the form of water, by combining with oxygen, and at the same time the hydrogen is replaced by an exactly equivalent quantity of oxygen. The same law led M. Dumas to his most recent discovery, that of chloro-acetic acid,—an acetic acid, in which chlorine is substituted for oxygen. One of the most interesting applications of this doctrine is that by M. Regnault, in elucidating the history of the chlorides of carbon. For the original discovery of these compounds we are indebted to Mr. Faraday. One of them which contains its two elements in the ratio of single equivalents has been named the protochloride of carbon. What is its real nature? M. Regnault has traced it through various compounds, all produced by the action of chlorine on ole-

fiant gas, by the abstraction of more and more hydrogen, and the substitution of a corresponding quantity of chlorine, till the whole four atoms of hydrogen of the olefiant gas are replaced by chlorine. This view, which represents the protochloride of carbon as consisting of four atoms of carbon and four of chlorine; or olefiant gas with its hydrogen replaced by chlorine, is consistent with the observed density of its vapor. Olefiant gas, also, has the four atoms of carbon belonging to alcohol from which it was formed, so that the protochloride of carbon has the carbon of alcohol from which it was primarily derived, and thus preserves, after numerous mutations, the most distinct traces of its origin. 2. The *binary theory of the constitution of bodies*, advocated by Liebig. This is the theoretical resolution of bodies, apparently the most complex, into not more than two proximate constituents, one of which, also, is generally a simple substance. There can be no doubt that compound radicals will be the basis of the classification of organic compounds, and that thus the same simplicity of arrangement will be introduced into organic compounds, as now exists in the metallic combinations of inorganic chemistry.

A communication was read from Prof. Hare, of Philadelphia, on *the preparation of barium, strontium and calcium.* By means of the alternate action of two deflagrators, each of 100 pairs, containing more than 100 square inches of zinc surface, assisted by refrigeration, Dr. H. has procured amalgams of these metals from their chlorides, and by distillation in an iron crucible, included in an air-tight alembic of the same metal, has extricated them from their mercurial solvent. (For full details, see this Journal, vol. xxxvii, p. 267.)

Mr. Coathupe, of Bristol, described an improved method of graduating glass tubes for eudiometrical purposes; and also exhibited an apparatus for determining the amount of carbonic acid in the atmosphere.

The Baron Eugene Du Mesnil gave a description of a safety lamp invented by him in 1834. It consists of a body of flint-glass, defended by a dozen of iron bars. The air is admitted by two conical tubes, inserted at the bottom, which are capped with wire-gauze, and enter by the side of the flame. The latter rises into a chimney, which has a piece of metal placed in the form of an arch over its top; the chimney being quite open. In consequence of this construction, a strong current is constantly passing

up the chimney. When carburetted hydrogen passes in, the fact is discovered by numerous small explosions, and the whole glass work is thrown into vibrations which emit a loud and shrill sound, audible at a great distance.

On a small Voltaic battery of extraordinary energy by W. R. Grove, Esq. In a letter published in the *Philos. Mag.* Feb. 1839, I stated, (said the author,) some reasons for hoping that by changes in the constituents of voltaic combinations of four elements, we might greatly increase their energy. At that period I sought in vain for improvements, which a fair induction convinced me were attainable; but being in the country, all my experiments were with copper as a negative metal. I was constantly unable to use concentrated nitric acid as an electrolyte, and its importance never occurred to me until forced upon my notice by an experiment which I made at Paris for a different object. This was an endeavor to prove the dissolution of gold in nitro-muriatic acid to be an electrical phenomenon; or rather, that this (and, as I believe with Sir H. Davy, every other chemical phenomenon,) could be resolved into an electrical one by operating on masses instead of molecules. The experiment was this: the extremities of two strips of gold leaf were immersed, the one in nitric, the other in muriatic acid; contact between the liquids being permitted, but mixture prevented, by an interposed porous diaphragm. In this case, the gold remained undissolved for an indefinite period, but the circuit being completed by metallic contact, either mediate or immediate, the strip of gold in the muriatic acid was instantly dissolved. Thus, it seems, that the affinity of gold for chlorine is not able alone to decompose muriatic acid; but when it is aided by that of oxygen for hydrogen, the decomposition is effected. The phenomenon bears much analogy to ordinary cases of double decomposition. The two gold strips in the experiment being connected with a galvanometer, occasioned a considerable deflexion; and it now occurred to me, coupling this experiment with my previous observations, that these same liquids, with the substitution of zinc and platinum for the gold leaf, would produce a combination of surpassing energy. My expectations were fully realized; and on the 15th of April, M. Becquerel presented to the Institute a small battery of my construction, consisting of seven liqueur glasses, containing the bowls of common tobacco-pipes, the metals zinc and platinum, and the electrolytes

concentrated nitric and dilute muriatic acids. This little apparatus produced effects of decomposition equal to the most powerful batteries of the old construction. Dilute nitric acid diminishes the energy; nitro-sulphuric acid acted as an electrolyte much as nitric acid; it is an excellent conductor, yielding oxygen at the anode, and hydrogen at the cathode. Applying this to my battery, I found it to succeed admirably, and hence a considerable diminution of expense on the side of the zinc; and I also found salt and water nearly equal to dilute muriatic acid. By using flattened parallelopiped-shaped vessels, the concentrated acid is much economized and the metals approximated. * * The rationale of the action of this combination, according to the chemical theory of galvanism, appears to be this. In the common zinc and copper combination, the resulting power is as the affinity of the anion of the electrolyte for zinc, *minus* its affinity for copper; in the common constant battery it is as the affinity of the anion for zinc, *plus* that of oxygen for hydrogen, *minus* that of hydrogen for copper. In the combination in question, the resulting power is as the affinity of the anion for zinc, *plus* that of oxygen for hydrogen, *minus* that of oxygen for azote. Nitric acid being much more readily decomposed than sulphate of copper, resistance is lessened and the power increased; and no hydrogen being evolved from the negative metal, there is no precipitation upon it, and consequently no counter-action. I need scarcely add a word as to the importance of improvements of this description in the voltaic battery. This valuable instrument of chemical research is thus made portable, and by increased power in diminished space, its adaptation to mechanical, especially to locomotive purposes, becomes more feasible.

Prof. Graham remarked on the *theory of the Voltaic Circle.* He first explained the received views of the propagation of electrical induction through the fluid and solid elements of the voltaic circle, by the formation of chains of polar molecules, each of which has a positive and a negative side, and in which no circulation of the electricities is supposed, but merely their displacement and separation from each other in the polar molecule. These electricities in the polar molecule of hydrochloric acid, for instance, are displaced, when the acid acts as an exciting fluid, and the positive electricity located in the chlorine atom, and the negative electricity in the hydrogen atom. These electricities are at

the same time, made the depositories of the chemical affinities of the chlorine and hydrogen respectively. Mr. G. proposed to modify this theory so far as to abandon the idea of electricities being actually possessed by these bodies, and to refer the phenomena at once to the proper chemical affinities of these bodies. He assigned similarly polar molecules to the exciting fluid and metals; and taking hydrochloric acid as a type of exciting fluids, he gave to each molecule a pole, having an affinity resembling that of chlorine, or *chlorous* affinity,—of negative electricity; and another pole, having an affinity resembling that of zinc and hydrogen, or *zincous* affinity, instead of positive electricity. He pursued the subject to a considerable length, illustrating his views by means of diagrams.

Dr. George Wilson gave an experimental demonstration of the *certain existence of haloid salts in solution.* All previous attempts to decide the question whether haloid salts do or do not decompose water, when dissolved in it, have afforded no certain results. The object of this paper is to show, that although the inquiry had long been abandoned as hopeless, a demonstration can be given of the persistent haloid condition of the dissolved haloid salts of the electro-negative metals. This the author appears to have satisfactorily demonstrated. It is mentioned as an incidental conclusion from the experiments recorded, that they afford a direct proof of the quasi-metallic character of hydrogen, so much insisted on by the advocates of the binary theory of salts; and that they supplied more direct evidence than any previous trials regarding this, since they not only demonstrate hydrogen to have the power of displacing many metals, but at the same time assign to it, as its proper place in its metallic character, a position intermediate between the electro-positive and electro-negative metals.

A paper was offered by Dr. S. Brown on the *Crystallization of Carburets;* having for its object to lay down a new form of the maxim of crystallization, viz. that when particles of a solid body are slowly evolved from the decomposition of a substance of which it, or its elements, are chemical constituents, they cohere in crystal, and that independently both of the fusion (or solution) of the body crystallized, and of the presence of any fluid medium of molecular action whatsoever. Dr. B. had obtained small crystals, colorless and intensely hard, of the carburets of iron, copper, zinc, lead, &c.

Dr. Clark read a paper on the *limits within which the equivalent weights of elementary bodies have been ascertained.* As the result of various researches, Dr. C. stated the following equivalents: viz.

Lead,	Least,	1292.65	Greatest,	1293.89	Mean,	1293.27
Sulphur,	"	199.45	"	200.77	"	200.09
Azote,	"	175.42	"	177.20	"	176.31
Carbon,	"	75.28	"	75.92	"	75.60

Dr. R. D. Thomson read an essay on the proofs of the *existence of free muriatic acid in the stomach* during digestion. He offered various reasons for doubting the certainty of the conclusion that muriatic acid thus exists, but that as the experiments which he had instituted in regard to the subject were not completed, he brought them forward at this time chiefly to show the necessity of further investigation.

Mr. Benson presented a paper on the *theory of the formation of White Lead.* He stated that white lead made from litharge, (protoxide of lead,) was rejected by painters. It is found that prepared in this way it is crystalline and partly transparent, whereas the ordinary white lead is amorphous and opake. It is found that in order to obtain the amorphous carbonate (or white lead) from litharge the latter must be supplied with a very minute portion of acetic acid.

Prof. Schönbein of Basle proposed a *new theory of the galvanization of metals.* The discovery of the chemical power of the voltaic pile, made at the beginning of the present century by British philosophers, drew the attention of the scientific world to the relations between chemical and electrical phenomena. Indeed, only a few years after this important fact had been ascertained, Davy and Berzelius did not hesitate to assert the theory, since generally adopted,—viz. that chemical and electrical forces are essentially the same. Prof. S. enumerates the results of several recent experiments which he considers as invalidating this theory. From these results he infers—1st. That neither common nor voltaic electricity is capable of changing the chemical bearings of any body, and that the principles of the electro-chemical theory, as laid down by Davy and Berzelius, are fallacious. 2d. The change which certain metallic bodies, when placed under the influence of a current, seem to undergo with regard to their chemical relations, is due to the production of some substance or

other, and its deposition upon those bodies by the agency of a current of electricity. 3d. The condition, *sine quâ non*, for efficaciously protecting readily-oxidizable metals against the action of free oxygen dissolved in fluids, is to arrange a closed voltaic circle, which is made up on one side, of the metal to be protected, and another metallic body more readily oxidizable than the former, and on the other side, of an electrolyte containing hydrogen, as water.

Prof. Shepard, of the Medical College of the State of South Carolina, gave an account of the *analysis of a meteorite*, in which he had detected chlorine and silicon.

On the composition of Idocrase, by Mr. T. Richardson. Mr. R. remarked that many of the formulæ of minerals are very incorrect representations of their constitution. Idocrase in this respect is greatly confused, and with the view of endeavoring to remove the discrepancies, Mr. R. made with great care the following analysis of specimens from the cabinet of Mr. Hutton.

No. 1 is Idocrase from Egg, in Norway. 2. Idocrase from Slatoush in Siberia. 3. Idocrase from Piedmont. 4. Vesuvian from Monte Somma. 5. Egerane from Eger, in Bohemia.

	1.	2.	3.	4.	5.
Silica,	38.75	37.45	39.25	37.90	38.40
Alumina,	17.35	18.85	17.30	18.10	18.15
Protox. Iron,	8.10	7.75	7.62	4.89	7.40
Protox. Manganese,	"	trace	3.50	"	trace
Lime,	33.60	35.25	32.25	34.69	33.09
Magnesia,	1.50	1.35	.47	3.23	3.02
	99.30	100.35	100.30	98.86	100.06

From these results it appears that Idocrase may be represented by the formula, $7(FO, MO, CaO, MgO)_3\ SiO_3 + 5Al_2\ O_3\ SiO_3$.

Dr. Ure gave a summary of his *experiments on fermentation*, from which among other results it is found that without the addition of yeast, much alcohol is generated in grain worts at an early period of the process of malting.

Prof. Reich communicated his researches on the *electrical currents in metalliferous veins* made in the mine Himmelsfurst, near Freyberg. Phenomena of this sort were first made known by Mr. Fox, and have been since confirmed by the observations of others. Reich considers their cause to be the hydro-electric action of the metallic components of the vein.

Mr. Exley presented a paper on the *relations of atoms in organic compounds*, comprising many very ingenious views and speculations, which cannot be well condensed.

Dr. Charles Schafhaeutl, of Munich, communicated the results of his inquiries into the *relative combinations of the constituents of cast iron, steel and malleable iron.* Among other things, he showed that the purest carbon contained and retained hydrogen, and sometimes azote, even at the highest temperatures. Pure iron cannot be welded; the welding power of iron depends on its alloy with the carburet of silicon. Steel as it comes out of the converting furnace or the crucible, is nothing more or less than white cast iron, of which Indian steel, called *wootz*, is the fairest specimen. Analyses were given of two specimens of cast iron and one of steel. It appears that the peculiarities of Swedish iron, depend in a great degree, on the presence of arsenic; and those of Russia iron on the presence of phosphorus.

Section C. *Geology and Geography.*

Dr. Buckland, the President of the Section, submitted a recommendation from a Society in Bradford, that the attention of members of Museums in provincial towns should be directed chiefly, if not solely, to the collection of specimens from their own immediate vicinities.

Dr. B. laid before the meeting the last number of M. Agassiz's work on *Fossil Fishes*, and spoke of the merits of that gentleman, who had sacrificed very flattering prospects in mercantile life to a love of science; being content to live almost in poverty, devoting his slender means to the furtherance of his undertaking. M. Agassiz had received pecuniary assistance from the Association; and to that body as well as to the English subscribers to his work, he was most grateful, for without such aid he must have abandoned the undertaking, so valuable to the scientific world, and especially to geology. Dr. B. stated the importance of fossil fishes to the geologist, their scales being preserved when their skeletons are destroyed; and made some observations on the adaptation of the covering of animals to the medium in which they live. He adduced the minute scales of the eel, covered over with mucus, to protect it from the mud,—this mucus preventing the scales from being grated or injured.

Mr Lyell read a paper on the *Tubular cavities filled with gravel and sand in the Chalk* near Norwich. The chalk near Norwich is covered with gravel, sand and loam, of variable thickness, much stained with iron, occasional masses of ferruginous sandstone being interstratified, in which are casts of the shells of the Norwich crag. The shelly crag itself forms here and there part of the same deposit. The outline of the chalk, at its junction with the incumbent gravel, is very irregular. In some places, tubular hollows, having the form of inverted cones, and filled with gravel and sand, are prolonged downwards to variousd epths into the chalk. These cavities vary in width from a few inches to 8 yards and upwards, and in depth from a few feet to more than 60 yards. Some are tortuous, but most of those at Eaton, two miles west of Norwich, are perpendicular. The materials filling the pipes agree precisely with those covering the chalk, with the exception that in the pipes they are unstratified. The pebbles in the gravel consist of rounded flint and quartz; but no shells or pieces of chalk, or any calcareous substance, occur in the pipes. In general, coarse sand and pebbles occupy the central parts of each pipe, while the bottom and sides are lined with a fine ferruginous clay, which however is permeable by water. This clay contains no calcareous matter. The chalk, for the distance of several inches, or even sometimes four or five feet from its junction with the sand pipe, is in a moist and softened slate, and contains a slight mixture of fine sand and clay, by which it is somewhat discolored. The chalk, at points more remote from the tubes, is white, pure, and perfectly soluble in acids. The pipes, which do not exceed a foot and a half in diameter, are often crossed by horizontal layers of flint nodules, which have remained in situ, while their chalky matrix has been removed. From this circumstance, the author infers that the pipes were due to the corroding action of water containing acid, which could not dissolve flint. But it is clear that the tubes were not first excavated to their present width and depth, and then filled subsequently and at once with gravel, for in that case the siliceous nodules would have been found in a heap at the bottom of each large cavity, having been derived from all the intersected layers of flint. This never happens, the larger flints being invariably dispersed irregularly through the gravel and sand which fills the tubes. Mr. L. therefore inferred that

the excavation and filling of the pipe proceeded contemporaneously and gradually, and that the flint nodules, when removed from their chalky matrix, subsided so as to rest upon sand and gravel which had previously sunk. As proving that the contents of the sand pipes came into their present position by slowly subsiding, the author mentioned the fact of strata of gravel elsewhere horizontally bending downwards into the mouth of a pipe, so as to become for a short space quite vertical within the pipe. He thought that the tubes, or at least some of the larger and deeper ones, were caused by springs impregnated with carbonic acid, which rose upwards through the chalk. But, afterwards, when these springs ceased, the descent of rain water, percolating the gravel, carried fine particles of sand and clay downwards, and deposited them at the bottom and sides of the tube, at all those points where the water was absorbed by the surrounding chalk. Some of the finer particles being carried into the chalk itself, caused the impurity and discoloration of that rock near the pipes. Mr. De la Beche mentioned that similar appearances are observed in other formations, as in green sand near Charmouth. Dr. Buckland agreed with Mr. Lyell as to the origin of the clay which lines these fissures. The gravel which covers the chalk he conceives to have been accumulated under salt water; and after the elevation of the strata, so as to become dry land, the clay lining was formed by the downward filtration of atmospheric water, carrying with it the material in solution. He did not agree with Mr. L. in considering these sand pipes as chimneys for the carbonic acid, as he saw no reason why the acid should come up in one place more than another, and a place serving as a chimney, should bear the marks of corrosion. Dr. B. concluded by instancing the example of fishes killed by carbonic acid, mentioned by Dr. Daubeny. In these, the death of the fish was very sudden, none living above five minutes. In volcanic districts the carbonic acid generated must have had a similar effect, and many specimens of fossil fish show the animals to have died suddenly, from the perfection of their preservation. He also insisted upon the importance of impressions of foot-marks, of atmospheric and of watery action on the surfaces of rocks, and stated that the most interesting point now in geology is the examination of those surfaces as they were exposed in different ages.

Mr. De la Beche called the attention of the meeting to the *geological map of Cornwall and Devon*, which he had made for the Ordnance Survey; it was universally admitted to be a most beautiful specimen of scientific topography.—Mr. J. E. Marshall exhibited a section across the Silurian rocks in Westmorland, from Shap Granite to Casterton Fell.—Rev. D. Williams read a paper on the rocks of South Devon and Cornwall, which was followed by a communication from Mr. Austen on the fossil remains of the limestones and slates of South Devon.

Mr. Lyell announced the *discovery*, in a crag pit at Newbourn, in Suffolk, *of the teeth of several species of mammalia.* The first of these fossils was determined by Mr. Owen, to be the posterior grinder of the lower jaw of the leopard. Mr. Wood, on receiving this intelligence, examined carefully a large collection of teeth from Newbourn, and they were found to belong chiefly to fishes of the genus *Lamna;* but among them was one which Mr. Owen has pronounced to be the molar tooth of a bear, and others which belong to a small ruminant. These fossils are all more or less broken, and there is no doubt they were found in the large pit at Newbourn, in which the teeth of fishes are abundant, in red crag. But, Mr. Lyell remarked, that there are many vertical fissures extending downwards to the depth of 30 feet and more, through the red crag at Newbourn; these fissures being filled with the detritus of shelly red crag. It is possible therefore, that the mammalian teeth may have been derived from the contents of these fissures, and may consequently belong to a qualified epoch, posterior to that of the red crag. Mr. L. however, inclines to the opinion that the teeth of the mammalia and fishes will prove of the same age; because, although the shells of the red crag are almost exclusively marine, yet Mr. Wood has discovered at places distant only a few miles from Newbourn, a fresh-water *Amiator*, the *Planorbis marginatus*, and two individuals of a land shell, *Auricula migosotis*, imbedded in the marine crag. The same river, therefore, that conveyed these shells to the sea, may also have carried down the remains of land quadrupeds. Mr. L. then mentioned the discovery of the teeth of an opossum in the London clay at Kyson, near Woodbridge. This fossil was obtained, together with the teeth of fish, from the upper part of a bed of sand about ten feet thick, which is covered by a mass of London clay about 17 feet thick. The clay is again covered,

at a short distance from Kyson by the red crag. Mr. Owen, on seeing this tooth, was clear that it could not belong to any of the decidedly carnivorous or herbivorous animals, but rather to some one of the mixed feeders, and having compared it with the teeth of the various tribes of quadrupeds included in that division, from the shrews to the monkeys, he found it to differ essentially from all of them, and he finally decided that it was marsupial, and one of the molars of a Didelphis allied to the Virginia opossum. Mr. L. immediately requested Mr. Wood and Mr. Colchester to renew their search in the same sand at Kyson, and they soon found a jaw and tooth, which Mr. Owen refers to a quadrumanous animal of the genus *Macacus*. The sand containing these remains is referable to the London clay; and this is the first instance of the fossil remains of quadrumana having been found in a deposit of the Eocene period. Cuvier had previously described a Didelphis from the Eocene fresh-water gypsum of the Paris basin. Mr. Lyell remarked, that the occurrence of an Eocene Macacus proved that the class most nearly approaching to man in its organization, was not limited, as some had supposed, to an era immediately antecedent to the creation of the human race. He also adverted to the great caution to be observed, when we reason from negative evidence in geology, as we do, where we infer the non-existence of certain classes of beings, at remote periods, from the mere fact of their fossil remains not having yet been found in ancient strata.

Mr. Bowman exhibited specimens of fossil fishes from Manchester, and submitted a communication upon them, from Mr. Binney. Scales and teeth of the sauroid fish, *Megalichthys*, are found in the low coal shales above the millstone grit in the Manchester coal field, and as far up as the fresh-water limestones of Ardwick. Remains of *Diplodus*, *Ctenoptychus*, *Holoptychus*, and *Palæoniscus* are found in greater abundance, though not so extensively disseminated. Some are found in a rock composed of the shells of a *Cypris* and a species of *Microconchus*, indicating a tranquil deposit of the bed as in a lagoon of a tropical climate. Some specimens are found quite close to the coal, but none have as yet been observed *in* it. The state of preservation and the position in which the fishes occur, lead to the conclusion, that they have been suddenly destroyed by water highly charged with decayed vegetable matter.

Mr. Strickland mentioned the *discovery of an Ichthyosaurus*, at Strensham near Tewkesbury, by Mr. Marrett, and also exhibited a fossil fish with cycloidal scales from the lias, a fact not agreeing with the hypothesis of Agassiz.

Dr. Wilde made a communication on *ancient Tyre*, and gave many interesting statements concerning the celebrated Tyrian dye.

Mr. Bowman read a paper on some *skeletons of fossil vegetables*, found by Mr. Binney, in the shape of a white impalpable powder, under a peat-bog near Gainsborough, occupying a stratum four to six inches in thickness, and covering an area of several acres. It appeared to be pure silica. On examination with high magnifiers, the powder was found to consist of a mass of transparent squares and parallelograms of different relative proportions, whose edges were perfectly sharp and smooth, and often traced with delicate parallel lines. On comparing these with the forms of some existing Confervæ, Mr. B. found the resemblance so strong, that he had no doubt they were the fragments of parasitical plants of that order, either identical with, or nearly allied to, the tribe *Diatomaceæ* which grow abundantly on the other Algæ.

Mr. Murchison exhibited a *geological map of Europe*, colored by Von Dechen, and the first part of a work on Petrifactions, collected by Humboldt in South America. The latter work has led to some important conclusions;—no oölitic or jurassic strata seem to exist in South America (or perhaps even in North America;) but there is a large development of the tertiary series, and a still larger of cretaceous, in the southern continent. Specimens of Silurian fossils had been brought to the present meeting of the Association, collected in North America, by Prof. C. U. Shepard of New Haven, Ct.

Mr. Murchison called the attention of the meeting to a section of a part of Germany which he had lately visited. Mr. Murchison stated, that having with Prof. Sedgwick, examined the older rocks of Western Germany and Belgium, it is their intention to lay before the Geological Society of London, a memoir, illustrated by fossils, on the classification of those ancient deposits, a succession of the Carboniferous, Devonian and Silurian systems. His present communication bore only on one point of this analysis, offering to prove the geological position of the anthracite or culm-bearing strata of Devonshire and Cornwall.

Dr. Buckland announced that the *Fossil Flora of Great Britain* was about to be continued by Messrs. Hutton and Henslow.—Dr. Lloyd mentioned the recent discovery of Saurian remains in Warwickshire.—Dr. Ward exhibited specimens and drawings illustrative of *impressions of the feet of animals* on the Greensill sandstone, near Shrewsbury. Greensill hill consists of a steep escarpment of new red sandstone, and contains four strata that have been described by Mr. Murchison, and in the second of which the impressions were found. This stratum when exposed to the atmosphere, always splits so as to exhibit ripple marks, and on these marks the impressions of feet have been observed, as well as marks of drops of rain. The latter are often in an oblique direction, as if having fallen in a gale of wind, the direction of which is thus pointed out. The foot-marks differ from those of the *Cheirotherium*, in having only three toes, armed with long nails, directed forwards, and not spread out. Nothing resembling the ball of the foot has been observed, except in a few, which have some resemblance to the impression of the foot of a dog.

Mr. Knipe read a communication on a *trap dyke* in Cumberland. Its length is 22 miles and its width from 20 to 30 yards. Its course coincides with that of the great Cleveland Dyke, and it is not improbable that they may be connected; if so, a basaltic dyke, 120 miles long, crosses our island from the Solway Firth to the German Ocean.

Mr. Darwin announced that a work on *fossil teeth* by Prof. Owen, will shortly be published.

A communication on *Peat-bogs*, by Dr. G. H. Adams, was read. The author had examined microscopically many specimens of peat, and had found them to consist of bundles of little capsules, somewhat like bunches of raisins, attached to the radicles of the plants growing on the surface of the bogs.—Mr. J. B. Yates read a paper on the *Changes and improvements in the embouchure of the Mersey.*—A paper was received from Mr. R. Garner on the *use of millstone grit in the manufacture of white earthen-ware.* Millstone grit has been used in Staffordshire for three or four years, being ground instead of flint, which is more expensive, as it must be calcined before grinding. The ware thus produced is as white, compact and durable, as that made by the former process.

Section D. *Zoology and Botany.*

A paper by Mr. Lankester was read, *on the formation of woody Tissue.* The tissues of plants, are for the sake of convenience, divided into *five;* but the origin of all these may be traced to the simple cell. How they are formed from the simple cell, is an undecided question, especially with regard to woody tissue. Du Petit Thouars supposes, that woody fibre is formed by the buds and leaves, and sent down by them between the bark and wood of the tree; whilst other writers suppose that it is formed from the bark or wood. The conclusions of the author, from all the known facts on the formation of woody tissue are :—1. That the requisites for the formation of wood, are a living tissue developing elongated fibres, a tissue forming and depositing secreted matter, and exposure to the influence of external stimuli. 2. That the secreted matters are more easily brought under the influence of external stimuli in the younger tissues; hence the importance of leaves. 3. That neither bark nor leaves are essential to the formation of woody tissue.

Notice of *Zoological Researches in Orkney and Shetland* in June, 1839, by Edward Forbes and John Goodsir. Their attention was directed almost wholly to invertebrate animals. Of *Mollusca*, they found four new species of *Eolida*, a new *Velutina*, and three apparently new species of *Ascidia*. Of the *Annelida*, they took great numbers; among others, the beautiful *Planaria atomata* of Müller, not before recorded as British. As to the *Radiata*, they were equally successful. The genus *Holothuria* holds its British court in Shetland, and the king of them is an enormous species, which the authors name *H. grandis*. Five other new species of this genus were found, and also a new species of *Ophiocoma*, of *Dianæa*, of *Oceanea*, of *Alcynöe*, and a minute animal, the type of a new genus among the *Acalephæ*. The most beautiful contribution to the British Fauna, from the Orkneys, is a zoophyte of the family *Tubulariadæ*, new both as a species and genus, and the largest known form of its tribe. It is about four inches long, and its stem half an inch in diameter. It belongs between *Tubularia* and *Coryne*, on the relations of which genera its discovery throws much light, as well as on the polypes in general. The authors propose to consecrate the genus to that great British zoophytist, Ellis, calling it *Ellisia*, and giv-

ing the species the appropriate name of *Flos maris*, as it may well be regarded, from its extreme grace and beauty, as the flower of the British seas.

Mr. Goodsir read a paper *on the follicular stage of dentition in the Ruminants, with some remarks on that process in the other orders of Mammalia.* He stated, that since the former meeting, he had detected the follicular stage of dentition in the pig, rabbit, cow and sheep. He had verified the fact, that all the permanent teeth, except the first molar which does not succeed a milk tooth, are developed from the internal surface of cavities of reserve, and that the depending folds of the sacs of composite teeth are formed by the lips of the follicles advancing inwards, after closure of the latter. He then described the progress of development of the pulps and sacs of the teeth in the cow and sheep, from their first appearance, as minute as possible, on the full surface of the membrane of the mouth, or on the internal surface of the cavities of reserve, till they have acquired their ultimate configuration. At an early period of the embryonic life of these animals, they possess the germs of canine and superior incisive teeth; the former existing as developed organs in two or three genera only of ruminants; the latter being found in the aberrant family of the camels. These germs have the form of slight dimples in the primitive groove, and after the closure of the latter, they remain for a short time opake nodules imbedded in the gum, in the course of the line of adhesion.

Mr. Wilde communicated his mode of *preparing fish for cabinet specimens*, and also read a paper on some new species of Entozoa, discovered by Dr. Bellingham.

Messrs. Edward Forbes and John Goodsir made a communication, *on the Ciliograda of the British seas.* The Ciliograda of the British seas belong to three genera, viz. Cydippe (Eschscholtz,) Alcynöe (Rang,) and Beroe (Linnæus.) Of the first genus, there are four species in these seas: of the second and third, two each.

Mr. G. Webb Hall made a communication on the *acceleration of the growth of Wheat.* He called the attention of the members to certain facts connected with the acceleration of the growth of wheat, and a consequent diminution of the time of its occupying the ground. The ordinary period of the growth of wheat is from the middle of October to the middle of August. Close observa-

tion under different circumstances, and a peculiar selection of seed and soil, have reduced the period of this plant to five months. A quick crop might be produced by pressing and compacting the soil, and in light soils, well manured, a quicker growth is ensured. One great means of obtaining early crops is the use of seed produced by plants that were themselves of early growth.

Mr. Felkin exhibited the results of an experiment in *the growth of silk at Nottingham.* The circumstances of the case had been unpropitious, but the result was successful. Land and labor being high in England, it is improbable that she can in silk culture compete with other countries, but in her colonies, and in the vast regions of Hindoostan, she has the means of raising immense quantities at a low rate. He imagined that the whole world might be supplied from India with raw silk, at half its present cost.

Mr. George T. Fox communicated some observations on whales, in connexion with an account of the *remains of a whale recently found at Durham.* In recently clearing out the rubbish from the basement story of the old tower of Durham Castle, the workmen were surprised to find several large bones; and as they advanced these accumulated, until twenty vertebræ, and about as many ribs were taken out, and also two large jaw bones. Mr. F. on examination, determined that the bones belonged to a spermaceti whale. The discovery excited much interest in the town, and while the subject was in agitation, Rev. Jas. Raine discovered a curious letter from Jo. Duresme to Mr. Stapylton, dated London, June 20, 1661, which at once accounted for the discovery of these animal remains. The letter clearly shows that the bones belonged to an animal cast on shore on the coast of Durham at Earington, in 1661; and it is therefore the oldest whale of the kind recorded to have been found on the British coast. The bones have been collected and set up in the Museum of Durham University.

Dr. Prichard read a paper *on the extinction of the human races.* He expressed his regret that so little attention was given to Ethnography, or the natural history of the human race, while the opportunities for observation are every day passing away; and concluded by an appeal in favor of the Aborigines Protection Society. The paper gave rise to a long and desultory conversation.

Next was read a ***Report on the distribution of the Pulmoniferous Mollusca in Britain, and the causes influencing it;*** drawn up at the request of the Association, by Mr. E. Forbes. The object of this inquiry was to ascertain the geographical and geological distribution of pulmoniferous mollusca in the British isles. The subject was considered under three heads; *first*, a view of the various influences which affect their distribution; *second*, a detailed view of the distribution of the indigenous species in the various provinces of Britain; and *third*, the relations of that division of the native Fauna to the Fauna of Europe, and the distribution generally of the more remarkable species.

Mr. J. E. Bowman exhibited specimens of a species of Dodder, *Cuscuta epilinum*, first found in Britain two years ago, by himself; and again in a new locality within the present month. He believes it is found exclusively on flax, and has been mistaken for *C. Europea*, from which however it is quite distinct.

A paper was read on the ***cultivation of the Cotton of commerce,*** by Major General Briggs. The objects proposed in the paper, are, 1. To excite inquiry on the various species of cotton plant that produce the cotton of commerce. 2. To ascertain the nature of the soils adapted to each. 3. To prove the practicability of cultivating the plant in India, for the supply of the British market to any extent. Of the species that produce the various cottons of commerce, we have at present very little accurate knowledge, and this has arisen from the alterations undergone by the plant in the process of cultivation. But there can be no doubt that the plants which produce cotton in America, Asia and Africa are of decidedly different species. The plant that produces the Brazil cotton, probably the *Gossypium hirsutum*, grows 15 or 20 feet high, is perennial, and produces cotton with a long and strong staple, and moderately fine and silky. The plant common to the West Indies, (said to have been imported from Guiana,) is triennial, bearing abundantly a fine silky long staple, and is the *G. Barbadense* of botanists. This also is the plant which produces the Sea-island cotton. When this plant was carried from the coast into the interior of Georgia and Carolina, the seed changed from a black to a green color, and the staple became shorter, coarser and more woolly. This plant was afterwards introduced into Egypt, and is the same that produces the Bourbon cotton, cultivated by the French on that island. Mr.

Spalding records several varieties, attention to which is of the greatest importance to the cultivation, since they vary in the character of their staple, in the shape and size of their pods, in the hue of the cotton, and in the duration of the plant. The common indigenous plant of India is the *G. herbaceum* of botanists, and differs in appearance from the cottons of the Western world; besides which there is the *G. religiosum*, producing the brown cotton extensively grown in China. The former plant is usually cultivated as an annual, but has been successfully treated and grown as a perennial, by the process of pruning down when the cotton is gathered. The produce of this plant is not inferior in fineness, and is superior in point of richness of color, to the best cottons of America. The staple is however short, and by the great neglect hitherto evinced in picking the produce at the proper time, and carelessness in allowing particles of dried leaves or the calyx of the flower to adhere to the wool, it brings a lower price, and is considered an inferior article in the English market, to the New Orleans and Georgian of America, though really superior in quality and durability. There is another kind of cotton produced from a species in Africa, which Dr. Royle considers allied to the *G. herbaceum* of India.

Mr. W. Danson made some remarks on the introduction of a species of *Auchenia* into Britain. Samples and manufactured specimens of Alpaca wool, in imitation of silk, (and without dye,) as black as jet, were exhibited. Mr. D. stated that the animals producing it ought to be propagated in Britain. Importations of the wool have already been made to the extent of one million pounds, and are likely to increase. There are five species of Llamas, of which, the *Alpaca* has fine wool, 6 to 12 inches long; the *Llamas*, hair which is very coarse, and the *Vicuña*, has a very short fine wool, more of the beaver cast. The wool of these animals would not enter into competition with the wool of sheep, but rather with silk. It is capable of the finest manufacture, and is especially suited to the fine shawl trade. The yarns spun from it are already sent to France in large quantities, at from 6*s*. to 12*s*. 6*d*. per pound, the piece of the raw Alpaca wool being now 2*s*. and 2*s*. 6*d*. per pound.

Prof. Jones made some observations on an apparatus for observing fish, (especially of the family Salmonidæ,) in confinement. He had prosecuted numerous inquiries in Scotland with reference

to the habits of the salmon and allied species, and with regard to the identity of various young and full grown fish.

Mr. C. C. Babington made an oral communication concerning some recent additions to the English Flora.—A letter was read from Mr. Garner, on the *Beroe pileus*, stating that he had not seen in this animal true luminosity, but only a peculiar luminosity in the dark. The external rows of ciliæ he believed might produce it. He had remarked, that if only one of the ciliæ were removed from this animal, it still continued to vibrate for many hours. He thought the currents in Beroe might be accounted for by ciliæ, which he observed to be placed in the whole of the interior of the animal. In the interior of the animal he had observed what appeared to him to be sacculi.

Section E. *Medical Science.*

After an introductory address from Dr. Yelloly, President of the Section, a paper by Sir David Dickson was read, containing abstracts of a remarkable case of rupture of the duodenum and of some other interesting cases.

Mr. Middlemore read a brief notice of the methods which have been used for the *removal of capsular cataract*, where the opake capsule remains after absorption of the lens, for the purpose of introducing to notice an instrument to facilitate the operation of extraction without interfering with the transparent structures of the eye. It consists of a needle, accompanied by a small forceps, the former capable of being withdrawn, leaving the latter to be fixed on the opake membrane and then withdrawn through the sclerotic, through which the needle had been introduced. He also detailed a case in which the operation for artificial pupil had been performed with success, and presented the patient for examination.

Dr. Foville, of Paris, presented a paper, detailing the results of his researches on the anatomy of the brain. He urged the advantages of examining the structure of the brain by manual separation rather than by section, and gave credit to Willis, as being the first advocate of this method.—Prof. Macartney read an essay on the means of repressing hemorrhage from arteries; giving the preference to metallic ligatures; and also a paper on the rules for finding with exactness the position of the principal arteries and nerves, from their relations to the external forms of the

body.—Dr. Blakiston read a paper on the sounds produced in respiration and on the voice.—Dr. G. Bird communicated observations on poisoning by the vapors of burning charcoal. Two opinions prevail on the mode in which this gas produces death. 1. That the gas acts negatively. 2. That the gas when respired, exerts a specific poisonous action on the nervous system. Dr. B. adopts the latter opinion.—Dr. Inglis read a paper, of which this was the summary:—1. Small pox is decidedly on the increase, and during each successive epidemic there is an increase of variolous patients from among those who were vaccinated in infancy. 2. The vaccine virus is as effectual now as it ever was, but revaccination is necessary after a period of years, as yet unknown. 3. The same cause which produces small pox during a variolous epidemic in the unvaccinated, may and does give rise to chicken pox in the vaccinated. 4. There is every reason to believe that cow pox had its origin in variola.—Mr. J. B. Estlin read a paper, to show, that the powers of the new virus diminish in intensity as successive vaccinations increased its distance from the cow.—Dr. R. D. Thomson, read a paper on alkaline indigestion, and gave the results of an extensive examination of patients laboring under this disease.—Mr. Hodgson read a paper on the red appearance on the internal coat of arteries, which he stated did not depend on inflammation in every instance, and from which it should be carefully distinguished.—Mr. C. T. Coathupe gave the results of a series of experiments on respiration. (See this Journal, Vol. xxxvii, p. 367.)—Dr. Costello presented a report of ten cases of calculus treated by lithotrity.—Mr. Nasmyth read a paper on the microscopic structure of the teeth, in which he treated also of the covering of the enamel and of the organization of the pulp. He subsequently read a paper on the structure of the Epithelium, (a layer of substance destitute of vessels, covering the vascular surface of mucous membranes,) which he described as being composed of cells.—Dr. L. Güterbock exhibited several instruments made from ivory, softened by the removal of the earthy matter by the action of dilute acid. He stated that the first idea of the preparation is contained in an English work published some time ago, entitled "Useful Arts and Inventions."

Section F. *Statistics.*

Mr. Clarke read a paper containing contributions to the educational statistics of Birmingham.

Mr. G. R. Porter read a paper entitled *suggestions in favor of the systematic collection of the statistics of agriculture.* Of the *material* interests affecting the well-being of a community, one of the most important subjects is doubtless that of an adequate supply of food for the people; and yet in England the subject has not hitherto been considered to any useful or practical end. It cannot even be ascertained from any authentic document, what quantity of land in the country is under cultivation. The author enforced with much earnestness the importance of establishing the necessary organization to secure the statistics in question, and also to diffuse among the agriculturists a knowledge of the improvements in the science of husbandry which are often limited to narrow districts. It has been stated that if all England were cultivated as well as the counties of Northumberland and Lincoln, it would produce more than double the quantity of food now obtained.

A report on the state of the working classes in three parishes in Rutlandshire, from facts collected by the Manchester Statistical Society, was read by Mr. Gregg.—Mr. Langton of the same society, read a report on the educational statistics of the county of Rutland. Taking the scholars of all ages, about 5 per cent. of the population attend evening and day schools only; 9.6 per cent. attend day and Sunday schools; 6 per cent. attend Sunday schools only.

Mr. Rawson read a very elaborate paper on the *criminal statistics of England and Wales.* Of his interesting results we can here state but one or two. The average annual number of persons committed or bailed to take their trial, during the last five years, was 22,174, of which more than half were for simple larceny. Both in England and in France the ratio of male to female criminals is about as 4 to 1.—Next was read a report by the Manchester Statistical Society on the borough of Kingston-upon-Hull.—Mr. Wharton made a report on the progress of the inquiries made by the committee instituted for the purpose of inquiring into the statistics of the mining districts of Northumberland, Durham and Yorkshire.—Mr. Clarke read a report on the commercial statistics of Birmingham, prepared by a local committee. It in-

cludes returns from the Savings Bank, Assay Office, Workhouse, &c. During the past year, 25,000 gold wedding rings had been assayed and marked. The number of steam engines is 240, of which 65 are high pressure, and the remainder condensing engines.—Prof. Powell read a paper on Academic Statistics, showing the proportion of students in the University of Oxford, who proceed on to degrees. Among other results it is stated that the ratio of the number matriculated to those who pass final examination, is 1 : 2.67.—Mr. Fripp read the report of the committee appointed to inquire into the condition of the working classes in Bristol. This document goes into minute details and exhibits immense labor.—Mr. Clark presented contributions to the medical statistics of Birmingham by a local committee, comprising elaborate returns from the town Infirmary, General Hospital, &c.

Section G. *Mechanical Science.*

Mr. J. I. Hawkins made a communication on *paving roads with blocks of wood*, placed with the grain in a vertical position. He considered that roads formed of sound wood, with the grain vertical, might be made so even as to constitute a sort of universal railway, on which carriages might be drawn by a small proportion of horse-power, and on which steam carriages might run as safely and almost as fast as on railways.—Mr. Scott Russell read a paper on *the most economical proportion of power to tonnage in steam vessels.* It is a subject of anxious inquiry when about to construct a new steam vessel, what is the best amount of power to place in the ship, so as to secure in the highest degree, economy, rapidity and regularity. The general principle at which after much study of the subject, Mr. R. had arrived, was this: that in a voyage by a steam vessel in the open sea, exposed of course, to adverse winds, there is a certain high velocity and high portion of power which may be accomplished with less expenditure of fuel and of room, than at a lower speed with less power.

Dr. Lardner read a very extensive paper detailing a series of experiments by himself and Messrs. Woods and Earle on the *resistance of the air to railway trains.* The following are his general conclusions. 1. The resistance to a railway train, other things being the same, depends on the speed. 2. At the same speed the resistance will be in the ratio of the load, if the carriages remain unaltered. 3. If the number of carriages be in-

creased, the resistance is increased, but not in so great a ratio as the load. 4. Therefore, the resistance does not, as has been hitherto supposed, bear an invariable ratio to the load, and ought not to be expressed at so much per ton. 5. The amount of the resistance of ordinary loads carried on railways at the ordinary speeds, more especially of passenger trains, is very much greater than engineers have hitherto supposed. 6. A considerable, but not exactly ascertained proportion of this resistance is due to the air. 7. The shape of the front or hind part of the train has no observable effect on the resistance. 8. The spaces between the carriages of the trains have no observable effect on the resistance. 9. The train, with the same width of front, suffers increased resistance with the increased bulk or volume of the coaches. 10. Mathematical formulæ, deduced from the supposition that the resistance of railway trains consists of two parts, one proportional to the load, but independent of the speed, and the other proportional to the square of the speed, have been applied to a limited number of experiments, and have given results in very near accordance, but the experiments must be further multiplied and varied, before safe, exact, and general conclusions can be drawn. 11. The amount of resistance being so much less than has been hitherto supposed, and the resistance produced by curves of a mile radius being inappreciable, railways laid down with gradients of from 16 to 20 feet a mile have practically but little disadvantage compared with a dead level; and curves may be safely made with radii less than a mile; but further experiments must be made to determine a safe minor limit for the radii of such curves; this principle being understood to be limited in its application to railways intended chiefly for rapid traffic.

Dr. Ure read a paper on the specific gravity or density of steam at different temperatures. Mr. E. Hodgkinson detailed some experiments made to ascertain the power of different species of wood to resist a force tending to crush them. The specimens for experiment were turned into right cylinders, about an inch in diameter and two inches long. Great discrepancies were found when the woods were in different degrees of dryness; wet timber, though felled a considerable time, bearing in some instances, less than half of what it bore when dry.—Mr. G. Cottam gave an account of the Marquis of Tweedale's patent brick and tile machine.—Mr. Fairbairn related some

experiments on the effects of weights acting for an indefinite time on bars of iron.—Mr. Scott Russell made a report on the proceedings of the Committee appointed to inquire into the best form for vessels, and explained the nature of the experiments in progress.—Mr. Cottam described a new railway wheel, made wholly of wrought iron, so welded together, that independent of screws, rivets, or other kind of fastening, they form one piece with the spokes.—Mr. Jeffries read a paper on warming and ventilating, and gave a description of a pneumatic stove.—Mr. Gossage communicated an account of a new rotatory steam engine.—Mr. Player made a communication on the application of anthracite coal to the blast furnace, steam engine boiler and smith's fire, at the Gwendraeth Ironworks near Carmarthen.—Mr. Davies gave a description of a machine for cutting the teeth of bevel wheels.—Mr. Dredge offered some remarks on bridge architecture.—A new secret lock without a key, by Mr. Benge, was then exhibited; and also a model, sent by Mr. Hamilton of Edinburgh, of a method by which the resistance caused by the pressure of the wind against the valves of the organ can be overcome, thereby permitting the largest pipes to be played by the fingers with facility, and also rendering the movement of the pedal keys and valves more smooth.

The amount of moneys granted at this meeting for the prosecution of scientific inquiries was £2789 14s. 7d.

ART. XV.—*Account of a Journey to the Côteau des Prairies, with a description of the Red Pipe Stone quarry and Granite bowlders found there;* by Mr. GEORGE CATLIN, *in a letter to Dr. Charles T. Jackson.*

Read in the Boston Society of Natural History, Sept. 4, 1839, and communicated for this Journal.

Dear Sir—In the summer of 1835, whilst visiting the tribes of Indians on the Upper Mississippi, I spent some months at and in the vicinity of the Falls of St. Anthony. Whilst there, I resolved to pay a visit to the "Red Pipe Stone quarry," (as it is called,) on the "*Côteau des Prairies*," the place where the Indians procure the stone for their red pipes; of which place I had already learned many very curious and interesting traditions from the Upper Mis-

souri tribes. From the exceedingly strange nature of these traditions and the great estimation in which this place is held by the savages, as well as from a full conviction in my own mind, that this pipe stone differing in itself from all other known minerals, might be a subject of great interest to science, I determined to see it *in situ*, and not only to understand its position and relations, but also to enable myself to give to the world, with more confidence, the strange and almost incredible traditions and legends which I have drawn from the different tribes, who have visited that place.

For this purpose I had made all the necessary preparations, and was to start in a day or two, accompanied by several officers and men of the garrison, whom Maj. Bliss, then in command, had allowed to accompany me. Just at this time however, we got news by a steamer which arrived from below, that Mr. Featherstonhaugh, was near the fort with fifteen men, in a bark canoe, on his way up the St. Peter's, having been sent by government to explore the Côteau des Prairies. At this intelligence, I immediately abandoned the journey, and taking a corporal with me from the garrison, descended the Mississippi in a bark canoe, to Prairie du Chien, and afterwards to Rock Island and St. Louis. In that city I learned on the return of Mr. Featherstonhaugh, that he did not go to the Pipe Stone Quarry, and I returned to New York in the fall, and in the succeeding spring, made a journey from that city, by the way of Buffalo, Detroit, Green Bay, Prairie du Chien, and Falls of St. Anthony, to the Côteau des Prairies, and the Red Pipe Stone Quarry, a distance of 2,400 miles, for which purpose I devoted eight months, travelling at a considerable expense, and for a great part of the way with much fatigue and exhaustion. At Buffalo I was joined by a young gentleman from England, of fine taste and education, who accompanied me the whole way and proved to be a pleasant and amusing companion.

From the Falls of St. Anthony we started on horseback with an Indian guide, tracing the southern shore of the St. Peter's River about eighty miles, crossing it at a place called "Traverse de Sioux," and recrossing it at another point about thirty miles above the mouth of "Terre Bleue," from whence we steered in a direction a little north of west, for the "Côteau des Prairies," leaving the St. Peter's River, and crossing one of the most beau-

tiful prairie countries in the world, for the distance of one hundred and twenty or one hundred and thirty miles, which brought us to the base of the Côteau. This immense tract of country which we had passed over, as well as that along the St. Peter's River, is every where covered with the richest soil, and furnishes an abundance of good water, which flows from a thousand living springs. For many miles in the distance before us we had the Côteau in view, which looked like a blue cloud settling down in the horizon; and when we had arrived at its base, we were scarcely sensible of the fact from the graceful and almost imperceptible swells with which it commences its elevation above the country about it. Over these swells or terraces, gently rising one above the other, we travelled for the distance of forty or fifty miles, when we at length reached the summit, and also the Pipe Stone quarry, the object of our campaign. From the base of this magic mound to its top, a distance of forty or fifty miles, there was not a tree or a bush to be seen in any direction; the ground was every where covered with a green turf of grass about five or six inches high; and we were assured by our Indian guide that it descended to the west, towards the Missouri, with a similar inclination, and for an equal distance, divested of every thing save the grass that grows and the animals that walk upon it.

On the very top of this mound or ridge, we found the far famed quarry or fountain of the Red Pipe, which is truly an anomaly in nature. The principal and most striking feature of this place is a perpendicular wall of close grained, compact quartz, of twenty five or thirty feet in elevation, running nearly north and south with its face to the west, exhibiting a front of nearly two miles in length, when it disappears at both ends by running under the prairie, which becomes there a little more elevated, and probably covers it for many miles, both to the north and the south. The depression of the brow of the ridge at this place has been caused by the wash of a little stream produced by several springs on the top of the ridge, a little back from the wall, which has gradually carried away the superincumbent earth, and having bared the wall for the distance of two miles, is now left to glide for some distance over a perfectly level surface of quartz rock, and then to leap from the top of the wall into a deep basin below, and from thence seek its course to the Missouri, forming the extreme source of a noted and powerful tributary, called the "Big Sioux."

This beautiful wall is perfectly stratified in several distinct horizontal layers of light gray and rose or flesh colored quartz; and through the greater part of the way, both on the front of the wall and over acres of its horizontal surface, it is highly polished or glazed, as if by ignition.

At the base of this wall and running parallel to it there is a level prairie of half a mile in width, in any and all parts of which the Indians procure the red stone for their pipes by digging through the soil and several slaty layers of the red stone to the depth of four or five feet. From the very numerous marks of ancient and modern diggings or excavations, it would appear that this place has been, for many centuries, resorted to for the red stone, and from the great number of graves and remains of ancient fortifications in its vicinity, (as well as from their actual traditions,) it would seem that the Indian tribes have long held this place in high superstitious estimation, and also that it has been the resort of different tribes, who have made their regular pilgrimages here to renew their pipes.

It is evident that these people set an extraordinary value on the red stone, independently of the fact that it is more easily carved and makes a better pipe than any other stone; for whenever an Indian presents a pipe made of it, he gives it as something from the Great Spirit; and some of the tribes have a tradition that the red men were all created from the red stone, and that it thereby is "a part of their flesh." Such was the superstition of the Sioux on this subject, that we had great difficulty in approaching it, being stopped by several hundred of them, who ordered us back and threatened us very hard, saying "that no white man had ever been to it, and that none should ever go."

In my notes on Manners and Customs of North American Indians, which will shortly appear, I shall give a very novel and curious account of their traditions and superstitious forms about this great medicine or mystery place.

The red pipe stone, will, I suppose, take its place amongst interesting minerals; and the "Côteau des Prairies" will become hereafter an important theme for geologists, not only from the fact that it is the only known locality of that mineral, but from other phenomena relating to it. The single fact of such a table of quartz, resting in perfectly horizontal strata on this elevated plateau, is of itself, as I conceive, a very interesting subject for investigation, and one which calls upon the scientific world for

a correct theory with regard to the time when, and the manner in which, this formation was produced. That it is a secondary and sedimentary deposit, seems evident; and that it has withstood the force of the diluvial current, while the great valley of the Missouri from this very wall of rocks to the Rocky Mountains has been excavated and its debris carried to the ocean, I confidently infer from the following remarkable fact.

At the base of the wall and within a few rods of it, and on the very ground where the Indians dig for the red stone, rests a group of five stupendous bowlders of gneiss leaning against each other, the smallest of which is twelve or fifteen feet, and the largest twenty five feet in diameter, weighing, unquestionably, several hundred tons. These blocks are composed chiefly of feldspar and mica of an exceedingly coarse grain, (the feldspar often occurring in crystals of an inch in diameter.) The surface of these bowlders is in every part covered with a gray moss, which gives them an extremely ancient and venerable appearance, while their sides and angles are rounded by attrition to the shape and character of most other erratic stones which are found throughout the country.

That these five immense blocks, of precisely the same character, and differing materially from all other specimens of bowlders which I have seen in the great valleys of the Mississippi and Missouri, should have been hurled some hundreds of miles from their native bed and lodged in so singular a group on this elevated ridge, is truly matter of surprise for the scientific world, as well as for the poor Indian, whose superstitious veneration of them is such that not a spear of grass is broken or bent by his feet, within three or four rods of the group; where he stops and in humble supplication, by throwing plugs of tobacco to them, solicits their permission (as the guardian spirit of the place) to dig and carry away the red stone for his pipes. The surface of these bowlders I found in every part entire and unscratched by any thing, and even the moss was every where unbroken, which undoubtedly remains so at this time, except where I applied the hammer to obtain some small specimens, which I brought away with me.*

* In a specimen with which we are favored by Mr. Catlin, the feldspar is in distinct crystals, is tinted red and greatly abounds; the quartz is gray and white, and the mica black, while the moss covers nearly half the mass.—*Eds.*

The fact alone that these blocks differ in character from all other specimens which I have seen in my travels, amongst the thousands of bowlders which are strewed over the great valley of the Missouri and Mississippi, from the Yellowstone almost to the Gulf of Mexico, raises in my mind an unanswerable question as regards the location of their native bed, and the means by which they have reached their isolated position, like five brothers, leaning against and supporting each other, without the existence of another bowlder of any description within fifty miles of them. There are thousands and tens of thousands of bowlders scattered over the prairies at the base of the Côteau on either side, and so throughout the valley of the St. Peter's and Mississippi, which are also subjects of very great interest and importance to science, inasmuch as they present to the world a vast variety of characters, and each one, although strayed away from its original position, bears incontestible proof of the character of its native bed. The tract of country lying between the St. Peter's River and the Côteau, over which we passed, presents innumerable specimens of the kind, and near the base of the Côteau, they are strewed over the prairie in countless numbers, presenting almost an incredible variety of rich and beautiful colors, and undoubtedly traceable, (if they *can* be traced,) to separate and distinct beds. Amongst these beautiful groups, it was sometimes a very easy matter to sit on my horse and count within my sight, some twenty or thirty different varieties of quartz and granite in rounded bowlders, of every hue and color, from snow white to intense red and yellow and blue, and almost to a jet black, each one well characterized and evidently from a distinct quarry. With the beautiful hues and almost endless characters of these blocks, I became completely surprised and charmed, and I resolved to procure specimens of every variety, which I did with success, by dismounting from my horse and breaking small bits from them with my hammer, until I had something like an hundred different varieties containing all the tints and colors of a painter's pallet. These I at length threw away, as I had on several former occasions, other minerals and fossils, which I had collected and lugged along from day to day, and sometimes from week to week.

Whether these varieties of quartz and granite can all be traced to their native beds, or whether they all have originals at this time exposed above the earth's surface, are generally matters of

much doubt in my mind. I believe that the geologist may take the different varieties which he may gather at the base of the Côteau in one hour, and travel the continent of North America all over, without being enabled to put them all in place; coming at last to the unavoidable conclusion, that numerous chains or beds of primitive rocks have reared their heads on this continent, the summits of which have been swept away by the force of the diluvial currents, and their fragments jostled together and strewed about, like foreigners in a strange land, over the great valleys of the Mississippi and Missouri, where they will ever remain and be gazed upon by the traveller, as the only remaining evidence of their native ledges, which have been again submerged or covered with diluvial deposits.

There seems not to be, either on the Côteau or in the great valleys on either side, so far as I have travelled, any slaty or other formation exposed above the surface, on which grooves or scratches can be seen, to establish the direction of the diluvial currents in those regions; yet I think the fact is pretty clearly established by the general shapes of the valleys, and the courses of the mountain ridges which wall them in on their sides.

The Côteau des Prairies is the dividing ridge between the St. Peter's and the Missouri rivers; its southern termination or slope is about in the latitude of the Falls of St. Anthony, and it stands equidistant between the two rivers, its general course bearing two or three degrees west of north, for the distance of two or three hundred miles, when it gradually slopes again to the north, throwing out from its base the head waters and tributaries of the St. Peter's on the east; the Red River and other streams which empty into the Hudson's Bay on the north; "La Riviere Jaques" and several other tributaries to the Missouri on the west; and the Red Cedar, the Ioway and the De Moines on the south.

This wonderful anomaly in nature, which is several hundred miles in length, and varying from fifty to an hundred in width, is undoubtedly the noblest mound of its kind in the world: it gradually and gracefully rises on each side, by swell after swell, without tree, or bush, or rocks, (save what are to be seen at the Pipe Stone Quarry,) and is every where covered with green grass, affording the traveller, from its highest elevations, the most unbounded and sublime views of—nothing at all,—save the blue and boundless ocean of prairies that lie beneath and all around

him, vanishing into azure in the distance, without a speck or spot to break their softness.

The direction of this ridge clearly establishes the course of the diluvial current in this region, and the erratic stones which are distributed along the base I attribute to an origin several hundred miles northwest from the Côteau. I have not myself traced the Côteau to its highest points, nor to its northern extremity, but on this subject I have closely questioned a number of travellers who have traversed every mile of it with their carts, and from thence to Lake Winnepec on the north, who uniformly tell me that there is no range of primitive rocks to be crossed in travelling the whole distance, which is one connected and continuous prairie.

The surface of the top and the sides of the Côteau is every where strewed over with granitic sand and pebbles, which, together with the fact of the five bowlders resting at the Pipe Stone quarry, show clearly, that every part of the ridge has been subject to the action of these currents, which could not have run counter to it, without having disfigured or deranged its beautiful symmetry.

The glazed or polished surface of the quartz rocks at the Pipe Stone quarry I consider a very interesting subject, and one which will hereafter produce a variety of theories, as to the manner in which it has been formed, and the causes which have led to such singular results. The quartz is of a close grain and exceedingly hard, eliciting the most brilliant sparks from steel; and in most places, where it is exposed to the sun and the air, its surface has a high polish, entirely beyond any result which could have been produced by diluvial action, being perfectly glazed as if by ignition. I was not sufficiently particular in my examinations, to ascertain whether any parts of the surface of these rocks under the ground and not exposed to the action of the air, were thus affected, which would afford an important argument in forming a correct theory with regard to it: and it may also be a fact of similar importance, that this polish does not extend over the whole wall or area, but is distributed over it in parts and sections, often disappearing suddenly, and re-appearing again, even where the character and exposure of the rock are the same, and unbroken. In general the parts and points most projecting and exposed, bear the highest polish, which would naturally be the case whether it was produced by ignition or by the action of the air and sun. It

would seem almost an impossibility that the air passing these projections for a series of centuries, could have produced so high a polish on so hard a substance, and in the total absence of all ignigenous matter, it seems equally unaccountable that this effect could have been produced by fire. I have broken off specimens and brought them home, which have as high a polish and lustre on the surface, as a piece of melted glass; and then, as these rocks have certainly been formed where they now lie, it must be admitted that this strange effect has been produced either by the action of the air, or by igneous influence, and if by the latter cause, we can come to no other conclusion than that these results are *volcanic;* that this wall has once formed the side of an extinguished crater, and that the pipe stone, lying in horizontal strata, was formed of the lava which issued from it. I am strongly inclined to believe, however, that the former supposition is the correct one, and that the pipe stone, which differs from all known specimens of lava and steatite, will prove to be a subject of great interest, and worthy of a careful analysis.

I inclose you fair specimens of every character to be found in the locality, and also a very slight outline of the place, copied from my original drawings.

Very respectfully yours, &c. GEO. CATLIN.

New York, March 4, 1839.

ART. XVI.—*Auroras and Sunset.*

I. *Notice of an Aurora Borealis, as observed at Rochester, N. Y.;* by Prof. C. DEWEY.

THE Aurora Borealis was splendid here as well as over the country on Tuesday eve, Sept. 3d, 1839. It was distinguished for its streams, and pillars, and cloudy-light—for centering at a point a little S. and W. of the zenith, from which it seemed to radiate in all directions, and extended greatly towards the south, as well as from the north. The yellow, white, and *crimson* light was splendid. There was no waving motion, like that in Jan., 1837.

I have an account from an observer in the middle of the State of Illinois, which may be relied upon. It is as follows:

"Sept. 3d, Brown Co., Ill. We had a splendid Aurora Borealis. The light first appeared in the northeast, of a yellow color, and spread round the horizon each way, nearly to the west on one side and southeast on the other side. The aurora then began to shoot up in brilliant pillars of yellow light below and rose-colored above. These pillars converged to a point, 3° or 4° S. of the zenith; there was no waving or rolling motion. As the brilliancy increased above, the northern horizon became dark, like a bank of fog unilluminated, and through it the stars were visible. Gradually it faded away, and bright places E. S. E. and W. N. W. were all that would attract attention. In about half an hour, most brilliant columns shot upward from these points, of yellow and crimson light, and all over the northern horizon pillars gradually developed themselves, and became extremely bright. Meanwhile, deep crimson light appeared in the southeast and stretched over to the N. W., forming a complete arch about 50° high, and under that another arch of a white light about 30° high, both distinct, regular and well-defined. The crimson one was absolutely intense in its color, as palpable as *blood*. This continued several minutes. All this time the dark bank was black in the northern horizon and probably 25° high. At length brilliant yellow pillars rose from the northern horizon through the dark bank at several points, and faded and rose again. Gradually the whole became less brilliant, and soon the splendor of the phenomenon was gone. It exceeded in splendor all that I ever saw, except that in January, two years ago." In this, as in many cases, the Aurora seems to be *black*, as well as *colored*. The *two* arches were not nearly so distinct as described in Illinois, though one was nearly complete for some time.

Is not the color of the light depending upon the *height* at which the electric fluid or Aurora is passing, the red making its way through the lower and denser parts of the atmosphere compared with the other? That the phenomenon has any connection with spiculæ of ice in the upper regions, appears most removed from any thing tangible.

II. *Aurora of Sept. 3d, as observed at Olean, N. Y.*

About half an hour after sunset a mild lighting up of the heavens in the north, as is usual, or very frequent at this season,

and in this latitude, was observed; but as the evening came on and the last light from the sun could no longer be seen, streaming rays darted up higher and more towards the zenith, while the base spread farther and farther around, until the whole horizon seemed the Auroral fountain. The atmosphere was almost entirely clear from the commencement, and what appeared for a time to be a cloud ascending from the southern horizon so suddenly vanished, that it left a doubt whether it were in reality a vapory sheet or merely a modified exhibition of this beautiful Aurora. At twenty minutes past eight, the whole vault of the sky seemed made of silvery stripes constantly changing positions, separating into blocks, and incessantly dancing from the horizon to the zenith, where they converged in a ragged cloud, that assumed, in its interval-existence, every conceivable shape.

The pencils, for the most part, were bluish white, with a tinge of leaden color; and there prevailed, during the whole display, more or less of a beautiful lake and a lilac, which being thrown occasionally like a mellow cloud over wide sections of the heavens, and combined with, or spread over the pencils, presented the richest arrangements of colorst hat, it would seem, could be gathered in the skies. In some stages, the lake gave to the sky that gorgeous appearance, observed at the rising of a summer-sun, when the clouds, thin and scarcely visible, are tipped with a deep crimson tinge. In others, it lay a broad band, unmoved by the flashes that played above and below. Like the lake, there was a sheet of white that moved about, distantly accompanied by smaller sheets or more properly segments of belts, unaffected by the flickering agitation observed above and around.

Toward the close of the exhibition, which was of interest until past ten, the sheaves of light were long, and looked, when the eye was turned a little from a direct view, like the dartings of tongued flame from a large furnace, only more brilliant, and of greater length. Being cut off in some places by bars of white clouds near the horizon, the interest of the scene was heightened by the more rapid movement which was apparent near the bases of the pencils.

The focus continued very near the same point, which was about four degrees directly south from the zenith. At times the point to which all the sheaves tended, would be glowing as if with accumulated light, that looked like a torrent at its entrance,

within a circle around of a few degrees in diameter; and again it would be a mere blank, all the pencils melting away before uniting.

Four meteors were seen to fall during the observations; one to the southwest, and the other three toward the south.

Observations.—Notes of the changes were at first taken once in from one to four minutes, and even these were not frequent enough to record all the changes; and oftentimes as many occurred during the time employed in writing a single remark as were witnessed in the intervals of employment with the pencil.

At 20 minutes past 8 o'clock the whole vault of the heavens was overspread with a series of alternating pencils of bluish white light, with the blue sky beyond, which converged to a point less than five degrees directly south from the zenith, a brilliant lake bar extending from the eastern to near the western horizon, about in the pathway of the sun.

23m. past 8. Red light in masses east and west of the zenith, the bar not continuous.

25m. past 8. Lake bar replaced and more brilliant than at first. Bright white ragged cloud in the centre.

27m. past 8. The lake or red in bright portions near the eastern and western extremes of the bar. Pencils in the south change from white to lilac and from lilac to white with great rapidity.

31m. past 8. Grown dim and again brightened up. Pencils most bright in S. E. and S. W.

34m. past 8. Intensely white pencils shoot up from the N. W. and N. E., most bright at the base.

Focus vanished and the crimson hues mildly shed all around.

35m. past 8. Focus re-established, with a bluish white group of rays radiating all about. The red pale, but most distinct in the west.

38m. past 8. Red in the west, but brightest in the northwest. Focus alternately vanishing and returning. Lilac and white about the zenith.

41m. past 8. Crescent in the focus and two parallel curved belts or crescents more nearly, of white in the southern heavens.

43m. past 8. Dim and thin vapory clouds rising in the south, tipped with the Aurora.

One bar of white light across the southern sky.

47m. past 8. Crescent inverted. Light growing more brilliant in the north and waning in the south.

50m. past 8. Bright pencils streaming up from a little north of east. Reddish or crimson hues barely perceptible.

53m. past 8. Clouds rising higher in the south.

55m. past 8. Crimson hues hardly to be discerned in the east and west. Flashes less rapid.

57m. past 8. Gathering again of crimson in the east. The rising clouds from the southern horizon are gorgeously lit up with the rays darting from behind them.

58m. past 8. Lake in the east is more like a sheet of flame than any thing else with which it may be compared.

2m. past 9. Lake in the east, as at the rising of a summer's sun. Supremely beautiful!

Below the clouds that have been climbing up from the south, lies a dark stratum of lilac.

4m. past 9. The bright sheet of lake in the east has ascended.

7m. past 9. A very bright ragged cloud constitutes the focus.

10m. past 9. Crimson almost gone.

15m. past 9. Crimson spread all over the north.

20m. past 9. The western sky decked with superbly brilliant red. Below a stripe of dark sky or cloud in the north, the pencils change so frequently and rapidly that the view is more like a glance at a fairy festival than at the mere sky.

25m. past 9. A broad stripe of very intensely brilliant lake, inclined at an angle of about 60° with the horizon, rising in the west and extending two-thirds of the way to the zenith.

30m. past 9. Growing dim.

35m. past 9. Lake most bright in the southeast. Light stripe resting upon a dark one about 3° in breadth.

40m. past 9. Fast growing dim.

45m. past 9. Flashings as of flame, more distinct than before. The white stripe of the south moved around to the west, accompanied above by the lake. Focus alternately existing and gone.

50m. past 9. Flashes more vivid and long. Crimson spreading around to the south.

5m. to 10. Lake again south and west, but most brilliant far, in the north. Lake in the south a stripe of 10° width, dim toward the margins.

10 o'clock. Crimson all gone.

5m. past 10. Flashing every where disappeared, except near the focus. Fogs coming on from the streams.

10m. past 10. Scattering broad sheaves of light, like fragments of thin white clouds, convergence of the pencils perceptible, but the focus disappeared.

Half past 10. All disappeared except the light of an ordinary Aurora in the north.

III. *Sunset at the West;* by Prof. C. Dewey.

To a native of New England, few objects appear more beautiful than the setting of the sun as it appears from the hills and valleys of her mountains. The clearness of the atmosphere, and the brilliancy of the colors, fasten his gaze upon the west as the sun has just sunk behind the mountains. As he passes, however, to the middle and western part of the State of New York, the sunsets become still more beautiful, and often absolutely splendid. The atmosphere does not appear more transparent and clear, but the variety of colors is greater, and they have a greater strength; the clouds show a more deep and brilliant reflection of red and yellow rays, and often the most splendid radiations of light soon after the sun has disappeared below the horizon. Those radiations have considerable uniformity, and yet they have much variety. They were well depicted in this Journal, Vol. xxxiii, p. 338–340. Between the broad radiating beams of red or yellow light, there is often the most beautiful and intense *blue.* If it is merely the common color of a clear sky, the intensity of the blue is greatly augmented by the contrast of the red or yellow light. Those radiations do not very often appear, although they occur many times in the course of several months. They begin sometimes so early as July, and do not cease till late in October. When the radiations do not appear, there is also an unusual splendor in the sunsets, transcending all I have ever witnessed in New England, or on the east side of the Allegany ridge. I have not been able to ascertain the peculiarity of the atmosphere when the splendid radiations are shown. They occur just after sunset, and last only for a few minutes. In the article referred to, it is suggested that the appearance may depend upon the reflection of the sun's light from the surface of the great lakes at the west of us. The supposition is very ingenious and interesting, but seems not to be true in fact, as is proved by the same appearances at the west of the lakes. In

the State of Illinois, the radiations are described as being even more beautiful and splendid than in this part of the state. From two individuals in distant parts of Illinois, I have received particular notices of the brilliancy of this *vision*, as compared with our own, by those who have admired it in both states. On the evening of July 4th, 1839, the sunset was splendid here, and more so in Illinois. An engineer in the middle of the state says, "the radiations like those of July 4th were not uncommon, at least in the summer of 1838. I noticed the appearance many times, and called the attention of others to it. Some facts are obvious. It never occurred before sunset, but from three to ten minutes after, and generally about five, and lasted from three to ten minutes—perhaps none of it ever remaining fifteen minutes after the sun had gone down. The radiations differed in breadth when compared one with another, and each increased in width with the distance from the sun, being one, two, or three, and perhaps four apparent diameters of the sun in breadth at the lowest visible part of the horizon. The color is generally pale yellow or straw color. Sometimes three radiations lie nearly along the horizon, diverging but little from it, of a reddish or rose color, and the more central radiations violet or bluish, not very vivid, but well defined, for the background seems always whitish. The central radiations sometimes extend nearly to the zenith, pale and diffused at the upper part, and generally from 30° or 40° to 60° long. Sometimes they occur on three successive days; when there has been little of storm for months; atmosphere very clear, and few clouds, and the sky too blue and brilliant to look at. The whole is beautiful. The sunsets are the most gorgeous that I ever beheld, and the hues upon the clouds are brilliant beyond description or comparison." No reflection from waters can account for these splendid appearances of nature.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Proceedings of the American Philosophical Society,** *January* 5, 1838.—The result of the annual election for officers held this day, was reported by the judges and clerks as follows:—

President.—Peter S. Du Ponceau, LL. D.

Vice Presidents.—Nathaniel Chapman, M. D., Joseph Hopkinson, LL. D., Robert M. Patterson, M. D.

Secretaries.—Franklin Bache, M. D., John K. Kane, Alexander D. Bache, LL. D., J. Francis Fisher.

Counsellors for three years.—Robert Hare, M. D., William Meredith, William Hembel, Jun., Charles D. Meigs, M. D.

Curators.—Isaac Lea, Isaac Hays, M. D., Franklin Peale.

Treasurer.—John Vaughan.

Mr. Lea read a paper in continuation of his memoir on fresh water and land shells, which was referred.

January 19, 1838.—Mr. Lea read a paper in further continuation of his memoir on fresh water and land shells, which was referred.

Mr. Walker presented to the notice of the Society, the drawings of a self-registering anemometer and rain gauge invented by Mr. Follett Osler, of Birmingham, England, of which he explained the character and advantages.

The Society elected John Vaughan, librarian.

Mr. Vaughan announced the death of Joshua Humphreys, a member of the Society, aged 86.

The following candidates were elected members:—

Capt. Andrew Talcott, late of the U. S. Engineers.

Thomas W. Griffith, Esq., of Baltimore.

Charles G. B. Daubeny, M. D., of the Univ. of Oxford.

Henry Reed, Esq., of the University of Pennsylvania.

William Norris, of Philadelphia County.

William Sullivan, Esq., of Boston.

February 2, 1838.—A letter was read from John K. Townsend, dated January 20th, 1838, announcing the transmission of the Indian Vocabularies collected for the Society, and of certain shells and geological specimens, selected for its use by Mr. Peale.

A communication from the late Joshua Humphreys, Esq., dated December 23d, 1837, was read, on the subject of the early history of

* We were ignorant until recently, that the American Philosophical Society published reports of their doings. Had these reports been earlier transmitted, they would have been sooner noticed.—*Eds.*

the naval construction of the United States, tending to correct an erroneous impression as to the opinions and wishes of President Washington on the subject of the navy, which had found place in Professor Tucker's Biography of Mr. Jefferson, and which had been the subject of remark by Dr. Harris in his Life of Bainbridge. This communication was referred to the Historical Committee.

The president communicated a letter to him from Mr. Tyson, of the House of Representatives of Pennsylvania, dated Jan. 29th, 1838, giving intelligence in relation to the ancient records of the State, and of the proposed publication of them at the public expense.

February 16, 1838.—Professor Henry, of Princeton, made a verbal communication on the lateral discharge of electricity, while passing along a wire as in the Leyden experiment, or communicated directly to an insulated wire, or to a wire connected with the earth; and detailed various experiments proving that free electricity is not, under any circumstances, conducted silently to the earth.

Dr. Bache announced the death of Dr. John Eberle, a member of the Society, who died at Lexington, Ky., on the 2d of Feb., aged 54.

March 2, 1838.—The Historical Committee announced that they had completed the publication of Mr. Du Ponceau's Dissertation on the Nature and Character of the Chinese System of Writing, forming volume second of the Historical Transactions of the Society.

Mr. Walker read a paper, entitled "Determination of the Longitude of several Stations near the Southern Boundary of Michigan; calculated from Transits of the Moon and of moon culminating Stars, observed in 1835 by Andrew Talcott, late Captain of United States Engineers."

The longitude of places in the United States, north of the Ohio, had hitherto depended on the observations of Ellicott and De Ferrer, made at points on the banks of the Ohio river, and on meridian lines drawn from this river, several hundred miles northward, by the deputy surveyors. From Mr. Walker's computations, it appears that *Turtle Island, Lake Erie*, has been placed only 1.7 geographical miles too far east on Tanner's map. Its true place is 41° 45′ 9″ N. latitude; and 5 hours, 33 min. 34.3 sec. W. longitude from Greenwich. Also, *South Bend Lake, Michigan*, has been placed 3.9 miles too far east; its true place being N. 41° 37′ 6″; W. 5 hours, 49 min. 15.3 sec. These observations of Capt. Talcott will prove highly useful to geographers, by furnishing standard points of reference in the northernmost part of the United States.

Mr. Vaughan announced the death of Benjamin Dearborn, of Boston, a member of the Society, who died on the 22d of Feb., 1838, aged 83.

March 16, 1838.—Mr. Lea invited the attention of the Society to certain facts, mentioned in a "Memoire sur quelques Acephales d'eau

douce du Senegal," by Mr. Rang, in relation to the torpidity of the Anodonta Chaiziana.

April 6, 1838.—Dr. Patterson announced the death of Dr. Nathaniel Bowditch, a member of the Society, who died on the 16th of March last, aged 63. Dr. Patterson was appointed to prepare a necrological notice of the deceased.

Mr. Du Ponceau mentioned the death, not heretofore reported, of Mr. Adet, a member of the Society, who died in March, 1834.

April 20, 1838.—Mr. Lea read a Note supplementary to his Memoir, now in the Society's press, on the subject of the Uniones, and permission was given to add the same to the principal communication.

The following candidates were elected members :—

William Harris, M. D., of Philadelphia.

Robert Treat Paine, of Boston.

John P. Emmet, M. D., of the University of Virginia.

Hugh S. Legare, of Charleston, S. C.

Samuel Breck, of Philadelphia.

Col. Sylvanus Thayer, U. S. Engineers.

Francis Wayland, D. D., of Brown University.

Henry Baldwin, of Pennsylvania.

William H. Prescott, of Boston.

May, 4, 1838.—Pursuant to appointment, Dr. Horner read a necrological notice of Dr. Philip Syng Physick, late a member of the Society. Dr. Horner having expressed a wish to make the same public, permission was granted to him to withdraw it from the files of the Society for publication.

Dr. Patterson read a letter from Professor Henry, of Princeton, dated May 4, 1838, announcing that, in recent experiments, he has produced directly from ordinary electricity, currents by induction analogous to those obtained from galvanism; and that he has ascertained that these currents possess some peculiar properties, that they may be increased in intensity to an indefinite degree, so that if a discharge from a Leyden jar be sent through a good conductor, a shock may be obtained from a contiguous but perfectly insulated conductor, more intense than one directly from the jar. Prof. Henry remarks that he has also found that all conducting substances screen the inductive action, and that he has succeeded in referring this screening process to currents induced for a moment in the interposed body.

Dr. Hare exhibited to the Society fourteen and a half ounces of platinum, fused by his hydro-oxygen blowpipe, and a specimen of pure platinum, freed from iridium by the process of Berzelius.

Dr. Patterson submitted to the Society's inspection, the log-book of the steam-ship Savannah, Capt. Moses Rogers, launched at New

York on the 22d of August, 1818; from which it appears that, after repeated voyages between New York, Savannah, and Charleston, this vessel left Savannah on the 24th or 25th of May, 1819, for Liverpool, saw Land's End on the 17th of June, and arrived at Liverpool on the 20th of June, having used steam thirteen days, and having exhausted her fuel (coal) three days before arrival. It also appears from the log-book that she left Liverpool on the 23d of July, arrived at Elsineur on the 9th of August, left Elsineur on the 14th of August, arrived at Stockholm on the 22d of August, left Stockholm on the 5th of September, arrived at Cronstadt on the 9th of September, and after several excursions between Cronstadt, &c., and Copenhagen, &c., left Arundel, Copenhagen, on the 23d of October, and arrived at Savannah on the 30th of November; that she subsequently arrived at Washington from Savannah on the 16th of December, after a passage of eleven days; that she was sold at Washington in September, 1820, and her engine taken out, after which she sailed as a packet, from New York to Savannah, until September, 1822, when she was lost. This log-book was supposed to derive additional interest from the recent arrival of the Sirius and Great Western, steam-ships, at New York, from England.

Dr. Mitchell repeated before the Society, Thilorier's process for solidifying carbonic acid, with an apparatus, made under his direction in Philadelphia, somewhat modified from that employed by Thilorier, and froze a quarter of a pound of mercury by the admixture of the solidified acid with nitrous ether.

May 18, 1838.—The Librarian read the translation of a letter from Pierre de Goetz to Mr. Du Ponceau, dated St. Petersburg, August 17th, (29th,) 1837, on behalf of the Imperial Russian Academy, announcing the transmission to the Society of the works which have been published by the Academy, numbering fifty seven volumes, and also of a donation of several volumes from himself personally.

Dr. Bache announced the death of Thomas Bradford, the latest survivor of the original members of the Society, who died on the 7th of May, 1838, aged 93 years and 3 days.

Dr. Hare communicated orally, that he has found that when the elements of water are exploded in contact with certain gases or essential oils, the aqueous elements, instead of condensing, combine with the hydrogen and carbon, and form a permanent gas.

June 15, 1838.—A communication was read, dated Cincinnati, May 7th, 1838, from Dr. John Locke, on the subject of Magnetic Observations, which was referred.

Dr. Dunglison announced the death of Thomas W. Griffith, of Baltimore, a member of the Society.

July 20, 1838.—Mr. Kane, from the Secretaries, reported that they had chosen Dr. Franklin Bache to be the Reporter of the Society.

The Committee appointed on the communication of Dr. John Locke of Cincinnati, read at the last meeting, [consisting of Messrs. Peter S. Du Ponceau, R. M. Patterson, and J. Saxton,] made the following report, which was adopted.

"The Committee to whom was referred the communication of Prof. John Locke of Cincinnati, report, that it gives the details of a series of experiments, made for the purpose of determining the magnetic intensity and dip for certain positions in Ohio. For these experiments he had furnished himself in London with the best apparatus, and had vibrated there two needles of the form recommended by Hansteen, and one in the form of a small flat bar. Five months afterwards, namely, on the 17th of January, 1838, he again vibrated these needles at Cincinnati, and found the ratio of horizontal intensity at the former place to that at the latter, as follows: by needle No. 1, as 1 to 1.1624; by needle No. 2, as 1 to 1.1639; by No. 3, as 1 to 1.2037. Of these results the author prefers the last; inasmuch as the magnetism of needles is liable to decrease, but not to increase.

"On the 20th of August, 1837, he made experiments with his dipping needle, to determine the dip at Westbourn Green, near London, the mean of which gives 69° 23′.3.

"On the 26th of November, 1837, the mean of a series of experiments made at Cincinnati, in lat. 39° 6′ N., and long. 84° 27′ W., gave the dip =70° 45′.75.

"At Dayton, Ohio, in lat. 39° 44′ N., and long. 84° 11′ W., the dip was found to be 71° 22′.75, on the 26th of March, 1838.

"At Springfield, Ohio, in lat. 39° 53′ N., and long. 83° 46′ W., the dip was found on the 29th of March, 1838, to be 71° 27′.375.

"At Urbana, lat. 40° 03′ N., long. 83° 44′ W., March 30, 1838, the dip was found =71° 29′.94.

"At Columbus, the seat of government of Ohio, lat. 39° 57′ N., long. 83° W., April 3, 1838, the dip was found =71° 04′.875.

"The interest of this paper is much increased by the circumstance that no accurate experiments on the intensity and dip of the needle have heretofore been made in the United States, west of the Alleghany mountains.

"The Committee conclude their report, by recommending that Prof. Locke's communication be printed in the Society's Transactions."

The claims of Dr. Henry Hall Sherwood to remarkable discoveries in magnetism were discussed: both his postulates and his deductions were considered erroneous. [For his claims, see this Journal, 34: 210.]

Dr. Bache announced the death of Charles Maurice Talleyrand, Prince of Benevento, a member of the Society, who died on the 17th of May, 1838, aged 83.

August 17, 1838.—On motion of Dr. Patterson, a Committee was appointed to observe the eclipse of the Sun of the 18th of September next. Committee, Dr. Patterson, Mr. Walker, Mr. Paine, and Capt. Talcott.

Sept. 21, 1838.—The Committee on the solar eclipse of the 18th of September, made a report in part, comprising the observations made at Philadelphia, the principal results of which are as follows:*

The observations made at Philadelphia are fifteen in number. A list of observers, telescopes, &c. is given in the following table. The correction in the third column is to be added algebraically to the latitude of the place of observation, to obtain that of the State House, +39° 56′ 58″. The correction in the fourth column is likewise to be added to the local longitude in time, to obtain that of the State House, + 5h. 0m. 39.2s.

No.	OBSERVERS.	Reduction to Latitude of State House.	Reduction to Longitude of State House.	Focal length in feet.	Maker of Telescope.	Description.	Screen Glass.	Estimated Power.
1.	E. J. Beans	—70.0	—1.70	2.5	Unknown.	Spy-glass	smoked	15
2.	Wm. Penn Cresson	— 1.8	" 5.20	2.5	Jones.	Achromatic	red.	30
3.	Prof. W. R. Johnson	— 1.8	" 5.20	3 5	Dollond.	"	"	100
4.	George M. Justice	—10.0	" 2.86	2.5	Jones.	Gregorian	"	80
5.	E. O. Kendall . . .	—10.0	" 2.86	2.5	Plössl.	Dialytic	green	50
6.	Joseph Knox . . .	—21.0	+1.39	3.5	Dollond.	Achromatic	red.	80
7.	Isaiah Lukens . . .	— 9.0	—0.86	1.8	Plössl.	Dialytic	yellow	20
8.	Thomas M'Euen .	+ 0.4	" 2.33	2.5	Dollond.	Achromatic	red.	60
9.	Prof. Roswell Park	— 6.5	" 1.30	2 5	"	Gregorian	"	50
10.	Dr. R. M. Patterson	— 1.1	" 1.20	5.0	"	Equatorial	"	100
11.	Wm. H. C. Riggs	+ 0.4	" 2.33	3.5	"	Achromatic	"	50
12.	Samuel Sellers . .	— 7.5	" 0.05	2.5	Jones.	"	"	40
13.	Tobias Wagner . .	—10.0	" 2.86	3.5	Dollond.	"	"	80
14.	Sears C. Walker .	—10.0	" 2.86	5.0	Tulley.	"	"	100
15.	William Young . .	+21.0	+1.39	7.0	Holcomb.	Herschelian	"	200

Phases Observed, in Mean Times of the Places of Observation.

No.	A.	B.	C.	D.	F.	H.	I.	K.	L.	M.	N.	O.	P.
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
	3 13	4 30	4 31	4 31	4 31	4 35	4 35	4 35	4 35	4 41	5 45	5 45	5 45
1			s			s							
			3.9			28.4							
2	s		−7.0		s.	27.8	s	s			s	s	
3	10.7		10.5	s	15.5	23.5	27.5	29.0			4.2	12.2	
4	7.4		6.3	12.8		27.3						11.3	
5	8.3			10.9		28.4						12.9	
6	12.8												
7				21.7				36.2					
8	13.0			18.1		29.1						13.2	
9		s		19.1		29.1				s			s
10	7.0	39.1		19.1		30.1				23.1		16.1	19.1
11	7.3	39.2	2.3	16.3		29.4		36.3				7.8	
12	6.0			16.0		31.0						16.0	
13	6.1								s				
14	5.6	36.7		15.6	23.0	28.0	29.5	37.0	42.0		10.0	13.0	16.0
15				12.9				38.9				15.0	

* For observations on this eclipse, made at Yale College, see Vol. xxxv, p. 174, of this Journal.—*Eds.* † Doubtful.

A. *Beginning.* Prof. Johnson noticed dark indentations for eight seconds after the first disturbance of the limb.

B. Arch of faint light, with speck or brush in centre, round the moon's limb beyond the cusps; brush or blaze in centre, between cusps, extending outwards about two digits. One cusp broken at end, presenting a bright bead.

C. Arch of light much increased in brightness; the brush or blaze, at first in the centre, now extends from cusp to cusp; radiation outwards, nearly three digits; cusps distant 30° on sun's limb, a broken point or bead at each end. This phase noted as that of the formation of the ring by Nos. 1, 2, 3, 4, and 11.

D. *Formation of ring, or instant of osculation of limbs.* This phase noticed as the approach of two sharp well defined points to a contact by Nos. 5 and 15. It was observed at the instant when the cusps, apparently 20° of the sun's limb apart, suddenly united by the extension of four or five luminous beads, or rounded portions of the sun's disc, by Nos. 3, 4, 8, 9, 10, 11, 13, and 14.

E. Omitted in the table. This letter refers to the time when the dark lines, described by Van Swinden and Baily, should have appeared. They were not seen by any observer, though carefully searched for.

F. Perfect ring, the beads of light having united, or run into each other suddenly.

G. Counterpart of E, not observed though looked for.

H. *Rupture of ring*, counterpart of D. Took place at a point, and so noted by all the observers.

I. Appearance of beads, five or six in number, extending from cusp to cusp.

K. Counterpart of C in every respect.

L. Counterpart of appearance just preceding C. Brush or blaze of light, narrowed down to a small space, 3° or 4° on the moon's border, extending outwards $2\frac{1}{2}$ digits; cusps still broken, as seen by most of the observers. Nos. 5 and 15, however, saw no irregularity of cusps, no beads of light.

M. Final disappearance of arch of faint light, with brush of light extending beyond the middle, having previously become very faint. This phenomenon observed with great care and certainty by No. 10.

N. Appearance of dark lines extending into the sun's disk, noticed by Nos. 3, 4, 10, and 14. The time noted by Nos. 3 and 14 as the end of the eclipse.

O. *End of eclipse*, inferred by each observer from his notes.

P. Final disappearance of the dark lines, the sun's disc having resumed its natural shape. Nos. 3, 4, 10, and 14 inferred the time of O as at some instant intermediate between N. and P. The time of external contact difficult to determine, on account of this irregularity.

For the convenience of computers, the local times above given have been reduced to their corresponding value for the State House by E. O. Kendall, by means of his formulæ, in Vol. xx, of the Journal of the Franklin Institute, p. 125, which gives the following values for the variation of the local times of the several phases, for a small variation of terrestrial latitude or longitude, as follows:—

	Beginning.	Ring.	End.
	s.	*s.*	*s.*
Variation for + or north 1″ terr. lat.	$=-0.0397$	-0.0382	-0.0343
Do. + or west 1*s.* of terr. lon. in time	$=-1.2600$	-1.1400	-0.9925

The means of his results for the State House, giving to each observation its proper weight, in mean time of the State House, are,

	h.	*m.*	*s.*
Beginning,	3	13	10.06
Formation of ring,	4	31	18.76
Rupture of ring,	4	35	31.35
End,	5	45	15.46
Duration of eclipse,	2	32	5.40
Duration of ring,		4	12.59

Mr. Du Ponceau presented a communication, entitled "A Vocabulary of the Language of the Valiente Indians, who inhabit the State of Costa Rica, in Central America, by Col. D. Juan Galindo, of Guatemala." Referred to the Historical and Literary Committee.

Mr. Nulty read a mathematical paper, entitled "New Formulæ relative to Comets, by E. Nulty, of Philadelphia." Referred to Dr. Patterson, Mr. Walker, and Capt. Talcott.

The subject of this paper was the component velocities of a comet, observed at three consecutive and moderately small intervals of time. In a preliminary notice of his subject and the means employed in its development, the author mentioned some advantages which he conceived to be attached to his peculiar mode of investigation. He alluded to different results already known, and, with several novel and general formulæ comprised in his paper, he announced two new sets of expressions which he represented as being directly applicable to the exceptive cases, in which particular observations render the forms hitherto given, doubtful or indeterminate. He also noticed a numerical application which he made of his formulæ and of others connected with the method of Laplace, to the data of the comet of 1803; and he intimated that a comparison of the results obtained by him in that and other instances, had led him to some remarks, which he inserted towards the close of his paper, from his opinion of their analytical and practical importance.

Dr. Patterson read a paper by Professor Charles Bonnycastle, of the University of Virginia, containing "Notes of experiments, made August

22d to 25th, 1838, with the view of determining the depth of the sea by the echo."

This paper, which was not offered for publication in the Society's Transactions, states that the generally received notions in regard to the intensity of sound in water, and the distance to which it is conveyed, had suggested to Mr. Bonnycastle, some years ago, the idea that an audible echo might be returned from the bottom of the sea, and the depth be thus ascertained from the known velocity of sound in water. The probability of this view was deemed at least sufficient to justify an experiment; and accordingly the Navy Commissioners authorized the construction of the necessary apparatus, and Captain Gedney, of the U. S. Brig Washington, attached to the coast survey, volunteered his services and the use of his vessel, and authority to this effect was liberally granted by the Secretary of the Treasury, Mr. Woodbury.

The apparatus, which is fully described in Mr. Bonnycastle's paper, consisted, first, of a petard or chamber of cast iron, $2\frac{1}{2}$ inches in diameter and $5\frac{1}{2}$ inches long, with suitable arrangements for firing gunpowder in it under water; secondly, of a tin tube, 8 feet long and $1\frac{1}{4}$ inches in diameter, terminated at one end by a conical trumpet-mouth, of which the diameter of the base was 20 inches, and the height of the axis 10 inches; thirdly, of a very sensible instrument for measuring small intervals of time, made by J. Montandon of Washington, and which was capable of indicating the sixtieth part of a second. Besides these, an apparatus for hearing was roughly made on board the vessel, in imitation of that used by Colladon in the Lake of Geneva, and consisted of a stove-pipe, $4\frac{1}{2}$ inches in diameter, closed at one end, and capable of being plunged four feet in the water. The ship's bell was also unhung, and an arrangement made for ringing it under water.

On the 22d of August, the brig left New York, and in the evening the experiments were commenced. In these, Mr. Bonnycastle was assisted by the commander and officers of the vessel, and by Dr. Robert M. Patterson, who had been invited to make one of the party.

In the first experiments, the bell was plunged about a fathom under water and kept ringing, while the operation of the two hearing instruments was tested at the distance of about a quarter of a mile. Both instruments performed less perfectly than was expected; the noise of the waves greatly interfering, in both, with the powers of hearing. In the trumpet-shaped apparatus, the ringing of the metal, from the blow of the waves, was partly guarded against by a wooden casing; but, as it was open at both ends, the oscillation of the water in the tube was found to be a still greater inconvenience, so that the sound of the bell was better heard with the cylindrical tube. At the distance of a quarter of a mile this sound was a sharp tap, about the loudness of that occasioned by

striking the back of a penknife against an iron wire: at the distance of a mile the sound was no longer audible.

In the second experiments, the mouth of the cone, in the trumpet apparatus, was closed with a plate of thick tin, and both instruments were protected by a parcelling of old canvas and rope-yarn, at the part in contact with the surface of the water. In these experiments the cone was placed at right angles to the stem, and the mouth directed toward the sound. The distances were measured by the interval elapsed between the observed flash and report of a pistol. At the distance of 1400 feet, the conical instrument was found considerably superior to the cylindrical, and at greater distances the superiority became so decided, that the latter was abandoned in all subsequent experiments. At the distance of 5270 feet, the bell was heard with such distinctness as left no doubt that it could have been heard half a mile further.

The sounds are stated in the paper to have been less intense than those in air, and seemed to be conveyed to less distances. The character of the sound was also wholly changed, and, from other experiments, it appeared that the blow of a watchmaker's hammer against a small bar of iron gave the same sharp tick as a heavy blow against the large ship's bell. It is well known that Franklin heard the sound of two stones struck together under water at half a mile distance; yet two of the boat's crew, who plunged their heads below the water, when at a somewhat less distance from the bell, were unable to hear its sound.

On the 24th of August, the vessel having proceeded to the Gulf Stream, experiments were made with the view for which the voyage was undertaken; that is, to ascertain whether an echo would be returned, through water, from the bottom of the sea. Some difficulties were at first presented in exploding the gun under water, but these were at length overcome. The hearing-tube was ballasted so as to sink vertically in the water. The observers then went, with this instrument, to a distance of about 150 yards from the vessel, and the petard was lowered over the stern, about three fathoms under water, and fired. The sound of the explosion, as heard by Mr. Bonnycastle, was two sharp distinct taps, at an interval of about one third of a second. Two sounds, with the same interval, were also clearly heard on board the brig; but the character of the sounds was different, and each was accompanied by a slight shock. Supposing the second sound to be the echo of the first from the bottom of the sea, the depth should have been about 160 fathoms.

To ascertain the real depth, the sounding was made by the ordinary method, but with a lead of 75 pounds weight, and bottom was distinctly felt at 550 fathoms, or five furlongs. The second sound could not, therefore, have been the echo of the first; and this was proved, on the following day, by repeating the experiment in four fathom water, when the double sound was heard as before, and with the same interval.

The conclusion from these experiments is, either that an echo cannot be heard from the bottom of the sea, or that some more effectual means of producing it must be employed.

Dr. Hare suggested the expediency of employing the Galvanic fluid to fire gunpowder below the surface of water, in experiments similar to those of Professor Bonnycastle.

The President laid on the table for the inspection of the members, an English and Japanese, and Japanese and English Vocabulary, by the Rev. W. H. Medhurst, late of Batavia, now in London, and a "Translation of a comparative Vocabulary of the Chinese, Corean, and Japanese Languages, to which are added the thousand Characters classic, in Chinese and Corean; the whole accompanied by copious Indexes of all the Chinese and English Words occurring in the Work," by the same author, under the name of Philo-Sinensis.

These two books, the President said, throw considerable light on the various graphic systems of the Indo-Chinese nations; they had been communicated to him by our associate, Mr. Pickering, of Boston, to whom they must be returned; he, therefore, recommended to the society to take measures to procure them for the library.

The recommendation of the President was then adopted, and the books referred to, ordered by the society.

Dr. Hare laid before the society, a specimen of platinum, weighing between twenty two and twenty three ounces, being part of a mass of twenty five ounces, fused by him in May last, by means of his compound blowpipe.

Dr. Hare also mentioned that he had observed, during a recent tornado at Somerset, Mass., various circumstances, which he detailed, all leading to the conclusion that a hiatus or place of rest exists at the centre of motion of the tornado.

Oct. 5, 1838.—The Committee on the solar eclipse of the 18th of September, made a further Report in part.

This portion of the report embraced the observations made in the vicinity of Philadelphia, of which the following are the principal results, arranged in the order in which they were received, and, with one exception, in mean time of the place of observation; the longitudes being reckoned from Greenwich.

No. 16, by Robert Treat Paine, Esq., at the west front of the Capitol, Washington. Latitude 38° 53′ 23″ N., as determined by Mr. Paine, with his Troughton's sextant. Longitude 5*h*. 8*m*. 8*s*. west. With 3½ feet equatorial, green screen glass. Time by three chronometers, regulated by eastern and western altitudes of sun and stars, with his Troughton's sextant.

	h.	*m.*	*s.*
Beginning,	3	6	9.58
Formation of ring,	4	24	28.15
Rupture of ring,	4	30	18.55
End,	5	39	54.89
Duration of eclipse,	2	33	45.31
Do. of ring,		5	50.40

"The ring formed instantaneously, and broke nearly so. No beads were seen, nor the dark lines mentioned by Mr. Baily, nor the light round the moon, although all were looked for. No distortion of the moon's limb could be seen, and the cusps of the sun, before the ring formed, were as sharp as needles."

No. 17, by Lieut. Gilliss, U. S. N., at the Marine Observatory, Washington City, N. 8″, W. 0.08*s.* in time, from the Capitol, with a 3¼ feet achromatic, green screen glass, power 50. Astronomical clock regulated by a five feet transit instrument.

	h.	*m.*	*s.*
Beginning,	3	6	10.4
Formation of ring,	4	24	28.4
Rupture of ring,	4	30	18.9
End,	5	39	56.4
Duration of eclipse,	2	33	46.0
Do. of ring,		5	50.5

"At beginning of eclipse, limbs sharp and well defined. The same at formation and rupture of the ring, only in the former the light seemed to flash round the moon's limb." Two detached arched portions of the ring were seen separated from the cusps, "while the space between presented points of light (beads) only."

No. 18, by Prof. Elias Loomis, at the Observatory of the Western Reserve College, Ohio. Latitude 41° 14′ 42″ N. Longitude 5*h.* 25*m.* 35*s.* W. With a five feet equatorial, mounted on a stone pier under a revolving dome, with yellow screen glass, power 150, nearly. Astronomical clock regulated by a 30 inch transit circle by Simms.

Beginning 14*h.* 27*m.* 26.7*s.* sidereal time.

Other phases lost by clouds.

Nos. 19 and 20, by J. Gummere and his son S. J. Gummere, at the Haverford School Observatory, Chester County, Pa. Latitude 41° 1′ 12″ N. Longitude 5*h.* 1*m.* 16*s.* W. With two 3½ feet telescopes by Tulley, with red screen glasses, powers 75, nearly. Astronomical clock regulated by a Dollond's portable transit instrument.

	h.	*m.*	*s.*
Beginning,	3	12	17.2
Formation of ring,	4	30	29.2
Rupture of ring,	4	34	44.8

	h.	*m.*	*s.*
End,	5	44	28.7
Duration of eclipse,	2	32	11.5
Do. of ring,		4	15.6

Arch of faint light, with brush in centre, seen before the formation of the ring. Arch seen after rupture, brush of light not recollected. Formation and rupture of the ring, by broken portions of the sun's border, several in number, not round like beads, but arched portions of the ring. These continued several seconds, and then suddenly united in the first instance, and separated in the last, without, however, exhibiting the dark lines figured by Baily.

Nos. 21 and 22, by Charles Wister and his son Caspar E. Wister, at the Observatory of the former, Germantown. Latitude 40° 1′ 59″ N. Longitude 2.7*s.* in time west of the State House. With 2½ and 2 feet Gregorian reflectors. Astronomical clock regulated by a 3 feet transit instrument.

	C. Wister.			*C. E. Wister.*		
	h.	*m.*	*s.*	*h.*	*m.*	*s.*
Beginning,	3	12	55.4	3	12	54.4
Formation of ring,	4	31	9.4	4	31	8.4
Rupture of ring,	4	35	18.4	4	35	18.4
End,	5	45	8.4	5	45	7.4
Duration of eclipse,	2	32	13.0	2	32	13.0
Do. of ring,		4	9.0		4	10.0

"The lucid points and dark intervening spaces corresponded closely to Baily's description."

No. 23, John Griscom. Latitude 9.7″ N., longitude 0.3*s.* in time west of the Observatory of Haverford School. With a 3½ feet Dollond achromatic, power 80.

	h.	*m.*	*s.*
Beginning,	3	12	18.6
Formation of ring,	4	30	31.6
Rupture of ring, (not reported.)			
End,	5	44	26.6
Duration of eclipse,	2	32	8.6
Do. of ring, (not reported.)			

No. 24, by Prof. James Hamilton, of Burlington, New Jersey. Latitude 40° 5′ 10″ N.: 69.1*s.* in time east of State House, Philadelphia. With a five feet achromatic, power 80. Clock regulated by equal altitudes with a sextant.

	h.	*m.*	*s.*
Beginning,	3	14	23.7
Formation of ring,	4	32	32.6
Rupture of ring,	4	36	19.6
End,	5	46	8.5

	h.	*m.*	*s.*
Duration of eclipse, ...	2	31	44.8
Do. of ring, ...		3	47.0

"The phases of the ring are the perfect formation and perfect rupture, without reference to beads. No dark lines seen."

October 19, 1838.—The Committee on the solar eclipse of the 18th of September, made a further Report in part, comprising the following observation:—

No. 25, by F. R. Hassler, Esq., at Weasel Mountain, N. J., latitude 40° 52′ 35″ N., approximate longitude 4*h*. 57*m*. 25.7*s*. W., being one of the stations of the coast survey, with telescopes of the large theodolite, powers 116 and 151.

	h.	*m.*	*s.*
First contact, ...	3	15	56.98
Inner contact, ...	4	35	57.09
End, ...	5	47	13.10
Duration of eclipse, ...	2	31	16.12
Do. of ring, ...			1.00

From a drawing, accompanying Mr. Hassler's communication, it appears that several broken portions of the ring, or beads of light, for a second only, extended from cusp to cusp, presenting a most beautiful appearance. During the rest of the eclipse, except this single second, the cusps were dull and rounded off at the end.

November 2, 1838.—The Committee on the solar eclipse of the 18th of September, made a further Report in part, comprising the following observations:—

Nos. 26 and 27. Observations of Professors Alexander and Henry, at the house of the latter, (lat. 40° 20′ 50″ N., lon. 4*h*. 58*m*. 37.2*s*. W. of Greenwich, being 0.1*s*. in time W. of Nassau Hall,) Princeton College, New Jersey; with a five feet Fraunhofer, yellow screen glass, power 60 for beginning and end, and 40 for the ring, and with a three and a half feet Dollond, dark red screen glass, power 80.

	h.	*m.*	*s.*	
Beginning, - -	3	14	42.71	Henry.
do. - - -	3	14	43.31	Alexander.
Formation of ring, -	4	33	11.27	Both observers.
Rupture of ring, -	(not observed.)			
End, - - - -	5	46	38.54	Henry.
do. - - - -	5	46	39.24	Alexander.
Mean duration of eclipse,	2	31	54.88	
do. of ring, (not observed) less than tabular duration.				

About two minutes before the formation of the ring, Prof. Henry saw, in the Dollond telescope with a red screen glass, an arch of faint light between the cusps, and shortly afterwards a brush of greater

intensity, projecting from near the lower cusp. This phenomenon was not seen by Prof. Alexander in the Fraunhofer with green screen glass, till 61 seconds before the formation of the ring, and then only as a luminous spot. This difference could not have been the result of any oversight on the part of Prof. Alexander; as Prof. Henry, immediately on seeing it, called out to Prof. Alexander, and described its appearance. The optical capacity of the Fraunhofer is superior to that of the Dollond. Prof. Alexander is well known for his nice observations of the annular eclipse of the 13th February, 1831, and of the total eclipse of the 30th November, 1834. Its explanation must be sought for in the nature of the rays of which this arch and brush of light are composed; rays absorbed by the green screen glass, and transmitted by the red. The moon's limb became brightly illuminated at 4*h*. 32*m*. 53.28*s*. "An appearance, similar to a row of beads, was regarded as the formation of the ring." "The drops endured for a second or two." Expecting a longer duration of the ring, the attention of the observers was not directed to the sun's limb at the instant of the rupture. The light succeeding the rupture of the ring was visible in the Dollond telescope till 4*h*. 41*m*. 16.27*s*., (the minute uncertain, perhaps a minute earlier,) having disappeared several minutes earlier in the Fraunhofer refractor.

No. 28. The beginning of the eclipse was observed by William Cranch Bond, at his private Observatory, with a two feet Gregorian, power 44; latitude 45° 19′ 15″ N., longitude 4*h*. 44*m*. 17.29*s*. west of Greenwich, (or 0.69*s*. in time west of Boston State House by Mr. Paine's trigonometrical survey,) as follows:—

Beginning, 3*h*. 28*m*. 10.90*s*. mean time of place of observation.

End, lost by clouds.

No. 29. The beginning was observed at 3*h*. 28*m*. 11.6*s*. at the State House, Boston, by Mr. Borden, with a 3½ feet refractor. Clouds prevented its observation at Cambridge.

The Committee also reported the following observations of R. T. Paine, Esq., on the occasion of his journey to Washington to observe the eclipse. These were made with his sextant, constructed by Troughton for the chronometrical survey of Massachusetts, and carefully corrected by that artist for all sensible error of eccentricity; and with three excellent chronometers used by Mr. Paine in the survey.

Latitude of the Capitol.

Sep. 17th, by 21 observed altitudes of both limbs				of the sun,	38° 53′ 23.39″
"	"	16	do.	β Ceti,	22.75
"	"	22	do.	Polaris,	21.77
"	22d	12	do.	both limbs of the sun,	22.31
"	"	12	do.	Polaris,	22.70
"	"	7	do.	β Ceti,	24.89
By mean of 56 altitudes of sun and southern stars,					23.16
do.	of 34	do.		Polaris,	22.24
				Latitude of the Capitol,	N. 38° 53′ 22.7″

The corrections of the chronometers were determined by Mr. Paine for Boston State House, from transit observations of Mr. Bond, at Dorchester; those for Philadelphia State House, by eastern and western altitudes of stars, observed at the High School Observatory, by Messrs. Paine, Riggs, Walker, and Kendall, with the Troughton's sextant, circle, a Pistor's sextant, and a sextant (maker's name unknown) reading to 10″. Those for Washington were made by Mr. Paine. The daily rates of the chronometers for Washington were on mean time,

		s.
151	Barraud	− 14.27
682	do.	+ 1.67
1678	Arnold	+ 8.46.

With these rates, the condition of the chronometers at the beginning of the eclipse was as follows:—

151 Barraud.		682 Barraud.		1678 Arnold.				
m.	*s.*	*m.*	*s.*	*m.*	*s.*			
+19	31.59	+25	11.27	+31	46.21	by 8 W.	alt's of sun,	Sep. 17.
	31.18		11.52		46.43	9 E. "	α Tauri,	"
	30.96		11.61		46.34	4 E. "	α Orionis,	"
	31.70		11.20		46.12	12 E. "	sun,	"
	32.65		12.13		47.14	8 E. "	α Androm.	18.
	31.70		11.38		46.34	12 E. "	sun,	"
+19	31.68	+25	11.48	+31	46.41	Mean of 53 altitudes.		

The longitude of the State House, Boston, is stated by Mr. Paine to be 4*h*. 44*m*. 16.6*s*. W., as the result of all the observations yet made. It is the same as that which Dr. Bowditch had deduced from those of 1811 and previous. The longitude of the State House, Philadelphia,

obtained by Mr. Walker from the principal observations made at Philadelphia to this time, is 5*h*. 0*m*. 39.2*s*. W. With these longitudes as standards, Mr. Paine's chronometric observations give,

			m.	*s.*	
Boston—Philadelphia by	151	Barraud	16	24.27	going from Boston to Phila.
	682	do.		22.30	do.
	1678	Arnold		24.03	do.
	151	Barraud		23.33	returning from Phila. to Boston.
	682	do.		23.60	do.
	1678	Arnold		23.76	do.

Philadelphia—Capitol by 151, 682, 1678 } Mean 7 26.43 going from Phila. to Capitol.

151, 682, 1678 } Mean 7 26.50 returning from Capitol to Phila.

	h.	*m.*	*s.*	*m.*	*s.*	*h.*	*m.*	*s.*
Hence, longitude of Capitol	=4	44	16.6	+23	50.01	=5	8	6.61
	=5	0	39.2	+ 7	26.46	=5	8	5.66
						Mean =5	8	6.14

Mr. Walker, in a paper read before the Society, March 2, 1838, from a discussion of all the observations then made at Washington, finds the longitude of the Capitol 5*h*. 8*m*. 7*s*. W., a value which is probably not far from the truth.

Thus we have an additional proof, if any were needed, of the error of 25 seconds in time of Lambert's longitude of the Capitol, reported to Congress, and adopted by that body.

The coincidence between the interval from Boston to Philadelphia, viz.

	m.	*s.*
By celestial phenomena,	16	22.60
By chronometers,	16	23.55

shows that the error of either is reduced within narrow limits.

The Mansion House, Northampton, Mass., lat. 42° 19′ 4.6″ N. by 327 altitudes of northern and southern stars, has the following longitude:—

	m.	*s.*	
Boston—Northampton,	6	17.72	by 74 chronometers.
do.	6	17.89	by immersion τ Sagittarii.
Northampton—Phila.	10	4.06	by do.

This immersion of τ Sagittarii was observed, Aug. 22d, 1836, as follows:—

	h.	*m.*	*s.*	
By R. T. Paine,	at 10	14	57.46	at Mansion House, Northampton.
By W. C. Bond,	at 10	23	20.90	at his Observatory.
By S. C. Walker,	at 10	1	7.30	at N. 4.4″, W. 1.06*s*. of State House, Phil.

Again, for the longitude of Brown University, Providence, Mr. Paine finds,

	m.	*s.*	
Boston—Providence,	1	22.64	by 40 chronometers.
do.	1	22.29	by eclipse of May 15th, 1836.

Mr. Paine's observations of the eclipse of Sept. 18th have already been reported. Those for latitude and regulation of chronometers have been stated more at length, in order to furnish examples of the method pursued by that gentleman in the chronometric survey of Massachusetts, the only work of the kind of much extent hitherto performed in this country. Some idea of the labors of Mr. Paine may be formed from the fact, that, during its progress, he has been under the necessity of making and reducing more than 100,000 observations of altitudes of the sun and stars, without any assistance.

It is proper to add that Mr. Gilliss's observations, already reported, appear to require a subtractive correction of 1.95*s*. Thus Mr. Paine's observations give,

	h.	*m.*		*m.*	*s.*
Sept. 18th,	21	25,	Barraud 151, fast by its own rate,	+19	20.80
			by comparison with 682 Barraud,		20.91
			1678 Arnold,		20.89
			by mean of three chronometers,	19	20.87
			by Mr. Gilliss's transit observations,	19	22.82
			Discrepancy,		1.95

Professor Henry read a paper entitled "Contributions to Electricity and Magnetism, No. 3. On the Phenomena of Electro-dynamic Induction." Referred to Prof. A. D. Bache, Dr. Patterson, and Dr. Hare.

The primary object of the investigation undertaken by the author, was the discovery of induced currents from ordinary electricity, similar to those produced by galvanism. Preparatory to this, a new investigation was instituted of the phenomena of galvanic induction, and the result of this forms, perhaps, the most important part of the communication.

The first section of the paper refers to the conditions which influence the induction of a current on itself, as in the case of a long wire and a spiral conductor. These are shown to depend on the intensity and quantity of the battery current, and on the length, thickness, and form of the conductor.

The next section examines the conditions necessary to the production of powerful secondary currents, and also the changes which take place in the same, when the form of the battery, and the size and form of the conductor are varied. The important fact is shown, that not only a current of intensity can be induced by one of quantity, but

also the converse, that a current of quantity can be produced by one of intensity.

The third section relates to the effect of interposing different substances between the conductor which transmits the current from the battery, and that which is arranged to receive the induced current. All good conducting substances are found to screen the inducing action, and this screening effect is shown, by the detail of a variety of experiments, to be the result of the neutralizing action of a current, induced in the interposed body. This neutralizing current is separately examined, and its direction found to be the same as that of the battery current. The question is then raised, how two currents in the same direction can counteract each other? An answer to this question is given in a subsequent part of the paper.

The fourth section relates to the discovery of induced currents of the third, fourth, and fifth orders;—that is, to the fact that the second current is found capable of inducing a third current, and this latter again another, and so on. The properties of these new currents are next examined, and the screening influence is found to take place between them; quantity is induced from intensity, and conversely; magnetism is developed in soft iron; decomposition is effected, and intense shocks are obtained, even from the current of the fourth order. A remarkable and important fact is stated in reference to the direction of these currents. If the direction of the battery current and that of the second be called *plus*, then the direction of the third current will be *minus*, of the fourth current *plus*, of the fifth *minus*, and so on. The application of the fact of these alternations is made to the explanation of the phenomenon of screening before mentioned, and also to the improvement of the magneto-electrical machine.

The last part of the paper relates to the discovery of secondary currents, and of currents of the several orders, in the discharge of ordinary electricity. Shocks are obtained from these; the screening influence of good conductors is shown to take place; magnetism is developed; and the alternations in the direction are found to exist as in the currents from galvanic induction. Some remarkable results are given in reference to the great distance at which the induction takes place. Experiments are detailed in which needles were made magnetic, when the conductors were removed to the distance of twelve feet from each other.

Prof. Henry made a verbal communication, during the course of which he illustrated, experimentally, the phenomena developed in his paper.

November 16, 1838.—The Committee on the solar eclipse of the 18th of September, made a further Report in part, comprising the following observations:—

No. 30. Observation of A. Holcomb, at his Observatory, Southwick, Mass., with a seven feet Herschelian of his own construction, power 225, with red screen glass. Southwick is in latitude 42° 0′ 41″ north; longitude 4*h*. 51*m*. 12*s*., by Mr. Holcomb's triangulation with Springfield Court House, one of the points determined by Mr. Paine. Mr. S. C. Walker finds, from Mr. Holcomb's observation of the solar eclipse of 1836, for this longitude 4*h*. 51*m*. 13.2*s*. Mean value 4*h*. 51*m*. 12.6*s*. W.

	h.	*m*.	*s*.		
Beginning,	3	20	19	Mean time.	Observation satisfactory.
End,	5	50	27	do.	Doubtful one second. Sun's limb
Duration,	2	30	8		tremulous, and near horizon.

No. 31. Observation of Prof. Albert Hopkins, at the Observatory of Williamstown College, Mass. Latitude, 42° 42′ 44″ N., longitude 4*h*. 52*m*. 52*s*. W. Astronomical clock regulated by a four feet transit instrument.

	h.	*m*.	*s*.		
Beginning,	3	17	19.9	Mean time.	Good observation.
End,	(not observed)				Sun too near the horizon.

The Committee on Dr. Hare's paper on the Tornado which passed over a suburb of Providence, R. I., in August last, reported in favor of publication, and the report was adopted.

The phenomena and facts, stated in this paper, are quite consistent with those mentioned upon the authority of Prof. Bache, Mr. Espy, and other observers, relative to the tornado which took place in New Jersey, at or near New Brunswick, in June, 1835, and of which an account will be found in the last volume of the Transactions of the Society. This paper embraced a letter from Zachariah Allen, Esq., a highly respectable gentleman of Providence, who was an eye-witness of the tornado, having been quite as near to it as was consistent with safety. One of the facts noticed by Mr. Allen, Dr. Hare considers as tending to justify his opinion, that the exciting cause of these meteors is electrical attraction. Mr. Allen alledged that, as soon as the tornado came into contact with the surface of the river, the water rose in a foam; that, under these circumstances, two flashes of lightning passed between the water and the overhanging clouds; and that, after each flash, there was a perceptible subsidence of the foam. This result is precisely what Dr. Hare conceives would ensue, if the foam arose from an attraction between the water and the stratum of air above, caused by opposite states of electrical excitement. In such case, the passage of sparks always necessarily tends to restore the equilibrium between the electrified masses, and consequently to lessen their reciprocal attraction.

Dr. Hare made a verbal communication in relation to his compound blowpipe. He stated that, having in a letter to the chemical section of the British Association, mentioned the fusion of twenty-five ounces of platinum, of which he had already informed the Society, a Mr. Maugham, who is employed at the Adelaide Gallery in London to exhibit the hydro-oxygen microscope, had asserted that the fusion in question had been accomplished by a blowpipe of a kind which he had contrived, and of which one had been bought by Dr. Hare when in London.

Dr. Hare said he would not have considered this ridiculous and groundless allegation worthy of notice, had it not been made before the chemical section of the British Association, and had not the individual, by whom it was made, been honored by a British society with a premium for the instrument which he miscalled *his* blowpipe. This blowpipe differed immaterially from one of which he, Dr. Hare, had published an engraving and description in Silliman's American Journal of Science for 1820, (Vol. II, page 298, fig. 3;) being a modification of his blowpipe described in Vol. XIV, of Tilloch's Philosophical Magazine for 1802.

The only difference between the instruments described and represented in those publications, and that employed by Maugham, was that the latter formed near the apex an acute angle, so as to be convenient for directing the flame upon a cylinder of lime for producing the lime-light.

With a view to show this method of illumination, agreeably to the process in which a revolving cylinder of lime is employed, Dr. Hare stated that he had purchased one of the crooked blowpipes alluded to; *but he had never used it for any purpose*, having found his own blowpipe above mentioned preferable, when the jet was directed obliquely upwards.

Unless cured of the crookedness, which was its only essential distinguishing attribute, the blowpipe used by Maugham was evidently unfit for the fusion of any metal. Dr. Hare stated that he would not undertake the fusion with it of an ounce of platinum; and concluded by saying, that whenever the process by which he had lately extended the power of his blowpipe should be published, it would be seen that however it might differ from those which he had previously contrived, it differed still more from that which Maugham had appropriated to himself.

Prof. Bache informed the Society, that, in conjunction with Prof. Rogers and Mr. Saxton on the nights of the 12th and 13th of November, and with Prof. Rogers and Mr. Walker on the 13th and 14th, he had observed the number of meteors or shooting stars. The first night

was clear for only about an hour, viz. between three-quarters past one and two, when but one meteor was seen. The second was clear until half past two; but not even an ordinary average number of meteors was seen.

On the authority of a letter from Mr. Levett Harris, Dr. Bache reported the decease of Mr. F. H. Le Comte, of Paris, a member of the Society.

December 21, 1838.—The Committee on the solar eclipse of the 18th of September, made a further Report in part, comprising the following observations, received through the attentions of their correspondent, Prof. S. Alexander, of Princeton College, New Jersey:—

No. 32, by Prof. Augustus A. Smith, of the Wesleyan University, Middletown, Conn. Latitude 41° 33′ 8″ N.: longitude as deduced by himself from this observation, by the method of Woolhouse, in the Nautical Almanac for 1837, 4*h*. 50*m*. 2*s*. W.

	h.	*m*.	*s*.	
Beginning, - -	3	22	0.81	Mean time.
End, - - -	5	52	1.46	Mean time.

His telescope was a Herschelian, by Holcomb, seven feet in length, six inches in aperture, with a deep red screen glass, power 150. "There was nothing unusual in the appearance, except, perhaps, about the time of greatest obscuration. At first were seen two or three brushes or pencils of light, streaming out from that border of the moon, which was not projected on the sun's disc, about equidistant from each other, and from the higher cusp of the sun. These soon disappeared, and were succeeded by a faint diffuse light, bordering two-thirds of the lower part of the sun's limb. The duration of this appearance was not noted."

Prof. Smith also noticed an indentation in the sun's limb, which he attributes to the protrusion of a lunar mountain, before any other portion of the moon was visible on the sun's disc. The Committee are of opinion that this appearance should be referred to that class of phenomena which usually precede and follow a central eclipse and which are to be ascribed to some optical cause rather than to the protrusion of lunar mountains.

No. 33, by Mr. I. N. Z. Blaney, at New Castle, Del., latitude 39° 40′ N., longitude 5*h*. 2*m*. 8*s*. W.; observation of the duration of the ring with a spy-glass, with smoked glass screen.

	m.	*s*.
From the appearance of the drops to the rupture of the ring,	4	47
From the perfect formation of the ring to the perfect rupture,	4	45

Prof. Alexander remarks that the luminous arch round the moon's dark limb, and the brush of light were only partially visible in his 4

feet Fraunhofer, with a yellow screen glass, having a slight tint of green. He saw them distinctly in the $3\frac{1}{2}$ feet Dollond, with a red screen glass, used by Prof. Henry, for some four minutes after the rupture of the ring, though none was visible in the Fraunhofer telescope; at least none is recollected to have been seen, though he examined the sun in the direction in which the ring broke. The testimony of so experienced an observer, who, in examining this arch and brush of light, used, interchangeably, the yellow and red screen glasses, in favor of their far greater visibility through the red screen glass, appears to be conclusive on the subject. This remarkable circumstance, not hitherto noticed in European observations, and first suggested by Robert Treat Paine, Esq., from his observations at Washington, appears to be now confirmed. It is one of great importance; as it seems to furnish evidence of the existence of a lunar atmosphere, through which, as through our own, the red rays have the greatest penetrative power. It also leads to new views concerning the cause of the remarkable appearances of the beads of light, and the dark lines frequently noticed; since it shows that their appearance may be completely modified by a change in the color, and, consequently, in the absorbing power of the screen glass through which they are observed.

The fact, noticed by most of the observers, that before the formation and after the breaking of the ring, the edge of the moon *off* the sun was distinctly visible, and illuminated for some distance within the moon's surface, is just such as would be presented by a *twilight* caused by a lunar atmosphere; nor does there seem to be any other plausible explanation of this phenomenon.

Mr. Lea submitted the following description of a new shell, recently taken in the vicinity of Cincinnati by Mr. T. G. Lea.

MELANIA CINCINNATIENSIS.

"Testâ valde depressâ, infernè compressâ, fuscâ, trifasciatâ, bicarinatâ, apice acuminatâ; anfractibus quaternis; aperturâ subrotundâ."

This is a very minute species, and very remarkable for its roof-shaped spire, and two carinæ which are colored.

On motion of Dr. Patterson, the Committee appointed on the late eclipse, were instructed to make and collect observations in relation to the occultation of stars in the constellation of the Pleiades, which will occur on the 27th instant.

January 4, 1839.—Dr. Dunglison made a verbal communication on the subject of the vaccine virus and its alledged liability to lose its protective character under certain circumstances.

He stated that, in consequence of severe epidemic small-pox having recently occurred in England, from which many who had been pre-

viously vaccinated had suffered severely, it had been a matter of solicitude with many medical practitioners to revert to the original source for vaccine virus. Mr. Estlin, of Bristol, having succeeded in obtaining some lymph from a cow laboring under cow-pox, inserted it in the arm of a young lady, in August last, and from her the disease was subsequently propagated. Some of the virus, obtained at ten removes, was sent to Dr. Dunglison by Messrs. Estlin and Carpenter of Bristol. This has been used in several cases, and the disease produced by it appeared to him to be more satisfactory than that which results from the old virus.

Dr. Dunglison stated that there was reason to believe that a sufficient supply of the new virus would soon be obtained for distribution through the country.

Professor A. D. Bache stated to the Society that observations had been made on the night of the 12th—13th of November last, by Professor Henry, at Princeton, Professor W. B. Rogers, at the University of Virginia, and Professor R. P. Smith, at Kenyon College, Ohio, neither of whom had noted an unusual number of the meteors commonly called "shooting stars."

January 18, 1839.—Professor A. D. Bache made a verbal communication relative to an extraordinary instance of the rapid corrosion of a chain cable in sea-water, reported to him by Lieutenant George M. Bache, of the U. S. Navy, and showed the Society a link from a portion of the cable.

The chain cable, of which this was a part, was used to anchor the Light-boat off Bartlett's reef, near New-London, Connecticut. The portion between the hawse-hole and the bridle of the anchors, about eleven fathoms in length, is particularly exposed to corrosion. In a few months the links, or the keys of the shackles attaching the chain to the bridle, become so much oxidated as to lose the requisite tenacity.

The link, presented as a sample of the chain, is irregularly oxidated and worn, presenting semi-spheroidal cavities, and the fibrous structure of the iron is very distinctly developed. While this is the case with the wrought iron part of the link, the cast iron stud which strengthens it is not materially acted on. The raised letters upon the stud are perfect.

The circumstances in which this chain is differently situated from others, used in similar situations, result from the peculiar construction of the Light-boat, by which the copper sheathing rises above, and is in contact with, the cast-iron hawse-pipe, through which the cable passes. This cast-iron pipe has on its exterior a lead pipe. The copper sheathing is bright.

This action being attributed by Lieutenant Bache, to the contact of the copper and iron in presence of sea-water, he had ordered the copper to be removed from around the hawse-hole, the result of which experiment would test the truth of the supposition.

Professor Bache stated his wish to call special attention to the entire soundness of the cast-iron, while the wrought-iron was corroded; as if the latter had acted as a protector to the former. He believed that some general laws of interest would be made out by the Committee of the British Association engaged in investigating the subject to which this fact appeared to belong.

The Committee on making and collecting observations of Celestial Phenomena, reported in part, that they had received the following observations of Lunar Occultations of the fixed stars, in mean time of the places of observation.

	1838.			h.	m.	s.			
1.	Nov. 2,	*d*	Pleiadum,	Em.	13	53 11.10	d. l.	Phila. Obs'ry.	W. and K.
2.		η		Im.	13	18 12.10	b. l.	"	"
3.				Em.	14	34 50.60	d. l.	"	"
4.		*f*		Im.	14	9 53.60	b. l.	"	"
5.				Em.	15	19 25.10	d. l.	"	"
6.		*h*		Em.	15	26 34.40	d. l.	"	"
7.	" 21,	58 ω	Sagittarii,	Im.	6	1 24.30	d. l.	"	"
8.			"	Em.	7	13 20.00	b. l.	"	"
9.		* 8th mag.	"	Im.	6	9 12.30	d. l.	"	"
10.		60 α	Sagittarii,	Im.	7	43 5.10	d. l.	"	J. and K.
11.	Dec. 27,	η	Pleiadum,	Im.	8	0 34.70	d. l.	"	R. and W.
12.				Em.	9	17 33.80	b. l.	"	"
13.		*f*		Im.	8	53 56.70	d. l.	"	P. and W.
14.						57.60	d. l.	"	K. and R.
15.		*h*		Im.	8	54 10.80	d. l.	"	P. and W.
16.						12.20	d. l.	"	K. and R.
17.	Nov. 2,	*d*	Pleiadum,	Im.	12	34 26.10	b. l.	Wagner's House,	T. Wagner.
18.				Em.	13	53 28.80	d. l.	"	"
19.		η		Im.	13	18 48.80	b. l.	"	"
20.				Em.	14	34 38.60	d. l.	"	"
21.		*f*		Em.	15	19 24.40	d. l.	"	"
22.		*h*		Em.	15	26 32.40	d. l.	"	"
23.	Dec. 27,	*d*	Pleiadum,	Em.	8	34 35.00	b. l.	"	"
24.		*f*		Im.	8	54 0.00	d. l.	"	"
25.				Em.	10	1 17.90	b. l.	"	"
26.		*h*		Em.	10	11 59.90	b. l.	"	"
27.	Nov. 21,	58 ω	Sagittarii,	Im.	6	3 57.35	d. l.	Princeton College,	Alexander.
28.		60 α	Sagittarii,	Im.	7	44 37.49	d. l.	"	"
29.	Dec. 24,	ι	Piscium,	Im.	9	35 30.80	d. l.	"	"
30.	" 26,	47	Arietis,	Im.	14	20 54.50	d. l.	"	"
31.	" 27,	η	Pleiadum,	Im.	8	4 0.35	d. l.	"	"
32.				Em.	9	21 30.40	b. l.	"	A. and B.
33.		*d*		Im.	7	21 33.50	d. l.	"	"
34.				Em.	8	38 38.00	b. l.	"	"
35.		*p*?		Im.	7	59 20.10	d. l.	"	A.

	1838.			h.	m.	s.			
36.	Dec. 27,	*f*		Im.	8	57	7.85 d. l.	Princeton College,	A.
37.				Im.			8.15 d. l.	"	B.
38.				Em.	10	6	11.30 b. l.	"	A.
39.		*h*		Im.	8	57	32.76 d. l.	"	A. and B.
40.				Em.	10	21	31.55 b. l.	"	A.
41.	Nov. 13,	α	Virginis,	Im.	20	32	38.40 b. l.	Dorchester Obs'y.	Bond.
42.	Dec. 2,	*c*	Aurigæ,	Em.	17	32	19.00 d. l.	Paine's House, Boston.	Paine.
43.	" 24,	ι	Piscium,	Im.	9	53	16.84 d. l.	"	"
44.	" 27,	*f*	Pleiadum,	Im.	9	18	43.28 d. l.	"	"
45.	Nov. 21, 58	ω	Sagittarii,	Im.	6	12	33.20 d. l.	Holcomb's Obs'y.	Holcomb.
46.	Dec. 24,	ι	Piscium,	Im.	9	44	29.50 d. l.	"	"
47.	" 27,	η	Pleiadum,	Im.	8	16	43.10 d. l.	"	"

No. 1, at the Philadelphia Observatory of the Central High School. Lat. 39° 57′ 8″ N.; longitude 5*h*. 0*m*. 42*s*. west of Greenwich.

No. 2, good observation. No. 3, doubtful, eye not directed to the exact place of emersion. Nos. 4, 5, 6, 7, 9, 11, 13, 14 and 15, good observations. No. 10, doubtful. No. 12, star reappeared in contact with bright limb.

No. 16, doubtful 1*s*.

No. 17, at T. Wagner's house, 2.16*s*. in time, east of the Philadelphia Observatory, with 5 feet equatorial. No. 18, probably too late several seconds.

No. 19, doubtful. No. 20, good observation, preferable to No. 3. Nos. 21, 22 and 24, good observations. Nos. 23, 25 and 26, uncertain, from brightness of moon's limb.

No. 27, at Prof. Stephen Alexander's house, 6″ north, 0.3*s*. in time, east of Nassau Hall, Princeton College, New Jersey.

Nos. 27, 28, 29, 30, 31, 32, 33, 36, 37 and 39, satisfactory observations.

Nos. 34, 38 and 40, uncertain from brightness of moon's limb.

No. 35, doubtful 1*s*. Nos. 33 and 36 appeared to be followed by a slight brush of light.

No. 41, at William Cranch Bond's Observatory, Dorchester, Mass. Lat. 42° 19′ 15″ N.; longitude 4*h*. 44*m*. 17.3*s*. W. of Greenwich.

No. 42, at R. T. Paine's house, Boston. Lat. 42° 20′ 56″ N.; long. 4*h*. 44*m*. 16.3*s*. W. Observation uncertain. Nos. 43 and 44, very good observations.

No. 45, at A. Holcomb's Observatory, Southwick, Mass. Lat. 42° 0′ 41″ N.; long. 4*h*. 51*m*. 15.5*s*. W.

The initials denote respectively,

W. Sears C. Walker.
K. E. O. Kendall.
J. George M. Justice.
R. William H. C. Riggs.
P. Robert M. Patterson.
A. Stephen Alexander.
B. J. V. Z. Blaney.

b. l. and d. l. denote respectively the bright and dark limbs of the moon.

The following candidates were elected members of the Society :—

James Prinsep, of Calcutta.

John Edwards Holbrook, M. D., of Charleston, S. C.

John C. Cresson, of Philadelphia.

James C. Booth, of Philadelphia.

Edward Coles, of Philadelphia.

J. F. Encke, of Berlin. A. Quetelet, of Brussels.

February 15, 1839.—The officers and council to whom was referred the letter of Doctor Warren, of Boston, inclosing a circular from a meeting of gentlemen at Boston, on the subject of the formation of an American Association for the Promotion of Science, submitted the following resolution, which was adopted by the Society.

Resolved, That the American Philosophical Society, having given the most respectful attention to the letters laid before them by Doctor W. E. Horner, and to the circular letter from the Committee of gentlemen of Boston, by referring the first letter to a Special Committee, and the second, with the circular, to the Board of Officers, are of the opinion, founded on the Reports of the Committee and of the Officers, that it is inexpedient for this Society to undertake the organization of an Association, such as is alluded to in these communications.

Doctor Patterson read an extract from a letter from Mr. T. R. Peale, dated November 13th, 1838.

In this letter Mr. Peale states, that observations had been made on the night of the 12th—13th of November, on board of the exploring vessel, the Peacock, (place not given,) relating to the number of meteors. The greatest number supposed to have been observed in any one hour was seventy-one. Mr. Peale expresses his doubts whether, from the motion of the vessel on the night in question, it was possible to be accurate on this point, and believes the number to have been much overrated.

A display of the Aurora Australis had been witnessed a few weeks before the date of the letter.

Professor A. D. Bache called the attention of the Society to a very convenient method for determining the magnetic dip and intensity, by one instrument, proposed by Professor Lloyd, of Dublin, and used by him, Major Sabine, and Captain James Ross, in the recent magnetic surveys in Great Britain.

The approximate dip is observed without disturbing the magnetism of the needle. The angle with the horizon, when the centre of gravity of the needle is removed from the axis by a small weight, is also observed, the needle being in the plane of the magnetic meridian.

To the first observation, a correction is applied, from observation at a station where the dip is accurately known, to obtain the true dip. The second being repeated at different places, the elements necessary to determine the relative intensities are known; and the approximate formula, connecting these observed elements with the relative intensities of the magnetism of the places where the change of intensity is not great, is very simple.

Prof. Bache showed an instrument, made by Robinson, of London, of the usual construction, for determining the magnetic dip, with needles for the employment of Professor Lloyd's method. He also re-

ferred to a method proposed by Professor Christie, of Woolwich, similar in principle, but differing in detail, and showed the needles for applying this method.

Prof. Bache further stated, that he had caused the method of heating these needles to the temperature of boiling water, to bring them to a permanent magnetic condition, as proposed by Prof. Christie, to be tried by Mr. Robinson. It had not proved successful.

Mr. S. C. Walker made a verbal communication on the parallax of the star, 61 Cygni, recently investigated by Mr. Bessel, and described the nature of the researches by which this important point had been established.

March 15, 1839.—Professor Henry, of Princeton, made a verbal communication relating to a phenomenon of capillary action which had fallen under his notice.

A lead tube, of about half an inch in diameter, and eight inches long, happened to be left with one end immersed in a cup of mercury; and on inspection a few days afterwards, it was observed that the mercury had disappeared from the cup, and was found on the floor at the other end of the tube. Struck with the phenomenon, the cup was again filled with mercury: the next morning the same effect was exhibited. The mercury had again passed over through the tube, apparently like water through a capillary siphon, and was again found on the floor.

On cutting the tube into pieces, it was evident that the mercury had not passed along the hollow axis, but had, apparently, been transmitted through the pores of the solid metal. To determine this, a lead rod about seven inches long and a quarter of an inch in diameter, was bent into the form of a siphon. The shorter leg was immersed in a watch-glass filled with mercury, and a similar glass placed under the end of the longer leg, to receive the metal which might pass over. At the end of twenty-four hours, a globule of mercury was perceived at the lower end; and in the course of five or six days all the mercury passed over, leaving a crop of beautiful arborescent crystals, of an amalgam of lead, in the upper glass.

The mercury did not pass along the surface of the wire, since the lead exhibited, externally, but little change of appearance; although the progress of the penetration could be traced by a slight variation of the color of the oxide on the surface.

The action is much influenced by the texture of the lead. When a rod of cast lead, of the same size and form, was substituted for the one before described, the globule of mercury did not make its appearance at the lower end until about forty days; and all the mercury of the upper glass had not yet (after three months) entirely disappeared.

The penetration takes place much more readily in the direction of the laminæ of the metal than across them. A plate of thick sheet lead was formed into a cup, and mercury poured into this; and it was found that before a drop had passed directly through, the mercury oozed out all around the edge of the plate.

Professor Henry stated that he had in progress a variety of experiments to investigate this action; and if any results of importance were obtained he would communicate them to the Society.

Dr. Hare made a verbal communication to the Society, by which it appears that he has obtained brilliant metallic spangles of calcium.

His processes have been, the deflagration of the phosphuret of calcium in an atmosphere of hydrogen; the exposure of the anhydrous iodide of calcium to a current of hydrogen,* or ammonia in an incandescent tube; the ignition of the pure earth or its carbonate or nitrate with sugar; or of the tartrate and acetate per se. Hence resulted carburets, which, after washing with acetic acid and rubbing on a porcelain tile, display the lustre of plumbago, intermingled with metallic spangles, of a brilliancy rivalling that of the perfect metals. The carburets, or the spangles thus obtained, are insoluble in acetic or chlorohydric acid, but yield to aqua regia. The carburets are excellent conductors of the voltaic fluid, as evolved by a series of 100 pairs; and, by deflagration in a receiver filled with hydrogen, yield metallic particles, which, rubbed on a porcelain tile, form spangles of a metallic brilliancy. By igniting antimony with tartrate of lime, Dr. Hare had procured an alloy of that metal with calcium, and expected by analogous means to alloy the metals of the earths with various metals proper. He believed that no effort to obtain calcium prior to his, had been more successful than the abortive experiment of Sir H. Davy, in which the tube broke before the distillation of the mercury was completed, with which the calcium had been amalgamated in the voltaic circuit, agreeably to the process previously employed by Berzelius. Dr. Hare had produced amalgams by exposing the chloride, or sulphide of calcium to the circuit; and, by distillation in an iron alembic, under the protection of a current of desiccated hydrogen, had isolated a portion of calcium, not however endowed with the whiteness or the lustre of that metal, as when otherwise fairly evolved. When distilled in glass tubes or retorts, he had found the amalgam to leave only a film upon the glass, devoid of any metallic attribute; although in one instance, to secure the absence of oxygen, he had mixed an amalgam of ammonium with that of calcium. Hence he inferred, that even though the tube of Davy had remained unbroken, that distinguished chemist

* By a deflagrator of one hundred pairs of plates, fourteen inches long by eight broad.

would not have found a residue of calcium, uncombined with the elements of the glass. That the spangles obtained by Dr. Hare from lime, were calcium, was ascertained by their solution in aqua regia, and the successive subsequent addition of ammonia and oxalic acid; the resulting precipitate being ignited, then redissolved and again precipitated as at first. No precipitate ensued from the addition of ammonia prior to that of the oxalic acid. Sulphydric acid produced a slight discoloration, but gave no precipitate. That the substances, resulting from the ignition of the carbonate with sugar, and washing with acetic acid, contained calcium in the metallic state, combined with carbon, was evident from their being insoluble in acetic or chlorohydric acid; from the deposition of carbon, and giving a precipitate of oxalate of lime on being subjected to aqua regia, ammonia, and oxalic acid; from their metallic brilliancy, when burnished, and from their being excellent conductors of the voltaic fluid. By the ignition of the carbonates of baryta and strontia severally with sugar, Dr. Hare had attained analogous results to those above mentioned in the case of the similar ignition of carbonate of lime.

The extreme avidity of calcium for iron was quite striking; since, when a crucible was inclosed in a clean iron case without a cover, the mass, swelling up so as to reach the iron, became slightly imbued with it. By intensely igniting the carburet of calcium, obtained from the carbonate and sugar, with an equal weight of dry tanno-gallate of iron, the whole of the aggregate became so magnetic that every particle was transferred from one vessel to another by means of a magnet. The mass was filled with minute metallic globules, which yielded only partially to chlorohydric acid, and which, when dissolved in aqua regia, gave, after adding ammonia and filtration a precipitate with oxalic acid.

Dr. Hare was aware that it did not seem consistent that spangles of calcium, burnished upon porcelain, should retain their lustre; as, under other circumstances, and especially when amalgamated, that metal was found to oxidize as soon as exposed to the air. He had, however, through the kindness of Mr. Booth, a pupil of Wöhler, procured a specimen of magnesium evolved by that celebrated chemist. This specimen yielded, under the burnisher, spangles of a lustre as enduring as that observed by Dr. Hare in the case of calcium. It should be recollected that slight causes may affect the oxidability of substances, as has been lately seen in the case of the reaction of iron with nitric acid; and it is well known that silicon, boron, and some other substances have two distinct states, in one of which there is a greater susceptibility of combination with other bodies than in the other.

April 5, 1839.—The Committee to whom was referred a paper, entitled "Contributions to the Geology of the Tertiary Formations of

Virginia, (second series,) by Prof. William B. Rogers, and Prof. Henry D. Rogers," reported in favor of the publication of the Memoir, which was ordered accordingly.

The object of this communication is to describe the geology of the peninsula embraced between the Potomac and Rappahannock rivers, extending from the Chesapeake Bay to the limit of tide water, near Fredericksburg.

This area consists almost exclusively of the two great divisions of the Tertiary Deposits of Virginia, namely, the *Eocene* and *Miocene* formations.

The paper commences with a sketch of the topographical features of the peninsula, making allusion, among other points, to the interesting *terraced* configuration of the land bordering the valleys of the two rivers. It then proceeds to delineate the boundaries of the *Eocene* and *Miocene* formations. The *Eocene* is shown to occupy the western part of the peninsula, overlapping at its western edge the secondary sandstone of Fredericksburg, and extending eastward with a very gentle eastern dip beneath the overlying Miocene deposits, until it finally disappears below the level of the tide near the mouth of Chingoteague creek on the Rappahannock, and Mathias's Point on the Potomac. The *Miocene* spreads eastward from the line connecting these two localities to the termination of the peninsula; while some of its lower beds extend west of the same line into the Eocene district, where they are confined, however, to the highest portions of the land.

After offering numerous details relating to the range and limits of these two divisions of the Tertiary Deposits, the paper treats in the next place of the arrangement and composition of the *Miocene* strata, which are shown to possess a close general analogy in these respects to the *Miocene* beds of the peninsula of the York and James rivers, described in a former communication. The two most interesting points of agreement are the occurrence of the blue marls low down in the series, and the presence of the thin band of ferruginous rock separating the *Miocene* from the overlying *diluvium*.

In general the blue marl at the base of the Miocene, is the most replete in fossils, though towards the eastern extremity of the peninsula, shells, &c., abound in the upper sands and clays. Usually the *upper* beds of the *Miocene* in this district are destitute of fossils, though full of their casts and impressions.

These strata consist generally of light colored sandy clays, distinguished by a sulphurous smell, and an acid and styptic flavor. Carbonate of lime is not abundant, but the sulphate of lime occurs sometimes in valuable proportion. Sulphate of iron, sulphate of alumina,

free sulphuric acid, sulphur, and even an appreciable amount of sulphate of magnesia are also met with.

The fossil impressions in these beds are beautifully distinct, and appertain to all the species of shells which are found in perfect condition in the subjacent strata. In the blue clayey marl beneath, there often occurs a notable proportion of green sand, which is also found in some of the other Miocene strata, mixed pretty largely with common sand and clay, in beds destitute of fossils.

The paper treats in detail of many of the more interesting localities in the *Miocene* district, describing the stratification, and presenting evidence of the relative fertilizing agency of the several beds.

The fossil species which characterize the *Miocene* strata, are next enumerated.

In the next section, an account is given of the arrangement and composition of the *Eocene* strata of the peninsula.

In general, the lowest bed of the series is a dark greenish-blue mass, composed of clay, fine sand, and a little green sand; while above it, the strata are of various shades, yellow, greenish-gray, and brown. Little uniformity prevails in their arrangement at different localities.

A thin band of ferruginous gravel frequently overlies the *Eocene* strata, and forms a distinct line of demarkation between them and the bottom of the *Miocene*.

The stratification of the Eocene at various localities is exhibited in detail, and the characteristic fossils specified, while the curious chemical changes which these have undergone, are also discussed.

Dr. Hays stated that he had received through a friend some of the vaccine virus, recently obtained by Mr. Estlin, of Bristol, from the cow, and had used it with the most satisfactory results. He exhibited a scab, which presented all the characters described by Jenner, as appertaining to the genuine vaccine scab.

April 19, 1839.—The Committee of Publication, reported the publication of Part Second, Vol. VI, of the Society's Transactions.

Professor Bache communicated at the request of the Committee on the Observatory, the following translation of a letter addressed to him by Professor Encke, Director of the Observatory of Berlin.

The nature of the operations of an observatory must depend more upon the individual taste and qualifications of the director than those of any other scientific establishment. There is still so much to be done in every department of Astronomy, in any one of which there is sufficient employment, that if a director shows a particular disposition for certain lines of research, it would be most profitable for science that he should be allowed to follow them, and not be tied

down to other observations. It would be best, therefore, that the director should be allowed to regulate his own establishment.

Large observatories, like those of Greenwich, Königsberg, and Dorpat, require, in the present state of science, large telescopes, the art of dividing having been carried so far, that small instruments will not answer. The necessity for large telescopes for the meridian instruments, as well as for other uses, renders such an establishment very costly, and requires that it shall be independent of others. It appears not to be the intention, at present, to erect such an observatory in the United States, and details in regard to it are therefore unnecessary.

But smaller observatories may also be useful to science, especially for geographical purposes. Such a one, for example, as would be furnished by a room with a solid foundation, connected with a second having a free horizon. The first to have cuts north and south and east and west, the second to have a turning dome. The following named instruments would be suitable for such an observatory.

1. A meridian circle with a 42 inch telescope and 20 inch circle, - - - -	1,000	Rix Dolls.
2. A telescope of 72 inches focal length, -	900	"
3. An astronomical clock, - - -	400	"
4. A chronometer, - - - -	500	"
5. Small transit instrument, - -	350	"
6. Small telescopes, barometers, thermometers, &c., a theodolite, &c, - - -	750	"
	3,900	"
	or about $3,000.	

A small observatory would thus be furnished for about three thousand dollars.

Determinations of the places of stars and planets, and even of the asteroids, may be made with the circle as far as the power of the telescope permits. Director Hansen, at Seeberg, and Professor Schwerdt, at Spire, have made excellent observations with a similar instrument. Observations of moon-culminating stars for longitude may be also made with it.

Observations of more difficult objects, except perhaps the nearest double stars, of comets, for the exterior of the planets, &c., may be made with the larger telescope.

The small transit instrument, placed east and west, will give the latitude within limits depending upon the accuracy to which the declinations of the stars are determined, and in conjunction with the chronometer, will serve to determine the geographical positions of places which may be selected. For longitude, observations are made

of the moon-culminating stars, which are observed at the same time with the meridian circle. For latitude, the transit is placed east and west.

The Altona Observatory may serve as a model of such a small observatory, and the yearly journeys of the Russian astronomers from Dorpat, as models for the use of the instruments in determining geographical positions. The observations of Professor Schwerdt, of Spire, will be found useful in the application of the meridian circle.

Such a small observatory will be well adapted to form observers; as the art of handling instruments so as to obtain accurate results is only to be acquired by practice.

Dr. Patterson made the following verbal communication:—

That the use of the wax tablet written on with an iron stylus, as practiced by the ancient Romans, had been tried, for the first time, this day, at the Pennsylvania Institution for the Instruction of the Blind, and that the success had been perfectly satisfactory. The blind read, with ease, the words written, traced geometrical figures, &c. It is confidently believed that the Roman tablet will prove of great importance in the instruction of the blind.

Professor H. D. Rogers made a verbal communication, in which he called the attention of the Society to a new compound of platinum, discovered by himself and his friend, Martin H. Boyé; upon the further investigation of which they are at present occupied.

It is a well characterized salt, composed of the deutochloride of platinum, and the binoxide of nitrogen, in which the former may be conceived, in accordance with the views of Professor Hare, to act the part of an acid, while the binoxide of nitrogen is in the relation of a base. It is of a bright gamboge yellow, is distinctly crystalline, though, in consequence of the minuteness of the crystals, their form has not been determined. It is highly deliquescent, absorbing water at ordinary temperatures, with great avidity, from the atmosphere.

It is rapidly decomposed by the mere addition of water, which causes an active effervescence; the binoxide of nitrogen being copiously evolved, and the deutochloride of platinum remaining in solution.

This interesting compound is best procured by evaporating a solution of platinum in *aqua regia* nearly to dryness, and then adding a large excess of fresh nitro-muriatic acid by small quantities at a time. The compound may thus be readily procured by filtering and pressing the powder between folds of bibulous paper. Should the concentration of the liquid be carried too far, it is requisite to add a little water, just sufficient in quantity to preserve the mass in a semi-fluid condition, and to prevent the precipitation of any deutochloride of platinum.

Specimens of the salt were exhibited, together with the apparatus employed in the qualitative examination of the compound, the constitution of which was made manifest by proper chemical re-agents.

The following candidates were elected members of the Society:

Humphrey Lloyd, A. M., of Trinity College, Dublin.

J. K. Paulding, Secretary of the Navy of the United States.

John Ludlow, D. D., Provost of the University of Pennsylvania

Benjamin W. Richards, of Philadelphia.

George W. Bethune, D. D., of Philadelphia.

George M. Justice, of Philadelphia.

May 3, 1839.—Prof. Bache called the attention of the Society to the donation of transparent models of crystals, presented to the cabinet by Prof. Alexander.

He stated that these models had all the advantages of those made from glass, with greater convenience in the construction of them. The thin plates of mica are readily marked with a sharp instrument, and easily cut. The parts are put together with diamond cement, it having been found that this is a much better method of connecting the pieces composing the model, than by cutting the sheets partly through and using the mica as a hinge, which renders the sheets liable to split. The forms resulting from the cleavage of crystals, &c. may be represented in these models as in those of glass.

Dr. Hays made a verbal communication relative to the catoptric examination of the eye, as a means of distinguishing the morbid conditions of the transparent tissues of that organ.

He stated that when a lighted candle is held before an eye, the pupil of which is dilated, and in which there is no obscurity of the transparent tissues, three distinct images of the flame are visible; two upright and one inverted, the latter appearing between the two former.

Experiments made to determine the causes of these reflected images, and the changes which occur in their number, position, &c. have shown that if a light be placed before the convex face of a single watch glass, or of several of them superimposed, one or more upright images of the flame will be seen, according to the number of glasses employed.* Now in the eye there are two superimposed convex surfaces, viz.—1st, the cornea; and 2d, the anterior capsule of the crystalline lens. Thus the formation of the two upright images is explained. Again, if a light be placed before the concave surface of a watch glass, an inverted image is seen. Such a surface

* To be strictly accurate, it should be said that each of these images is double, for one is reflected from each surface of the glass, and these images are the more distinctly double, the thicker the glass.

exists in the eye, in the posterior capsule of the lens; and thus the third image is accounted for.

M. Sanson, a distinguished French surgeon, has taken advantage of the above facts, to distinguish cataract from amaurosis, and has been enabled to determine by this means some cases of supposed amaurosis to be in fact cataract, and has treated them successfully by operation.

Dr. Mackenzie, an eminent ophthalmologist of Glasgow, has also employed this means to determine the condition of the eye in glaucoma. Dr. Hays remarked that he had resorted to the catoptric examination of the eye in many cases, and believed that it would prove as valuable a means of diagnosis in some of the diseases of the eye, as auscultation is in those of the chest.

Dr. Hays exhibited and explained several models, designed and constructed by Dr. John Neill, resident surgeon at Wills' Hospital, for the purpose of illustrating the catoptric phenomena just explained.

Dr. Patterson communicated verbally a method of using thin sheets of lead by the blind in writing, reading, and musical notation, invented by Mr. Joseph Saxton. The sheets of lead are three thousandths of an inch in thickness. Dr. Patterson presented specimens of the writing and musical notation.

Dr. Bache communicated the decease of Mr. George Pollok, a member of the Society, who died in April last.

May 17, 1839.—Dr. Hare made the following verbal communication relative to the blasting of rocks by the aid of galvanic ignition in firing the charge.

The Doctor called the attention of the Society to the fact, that he had, so long ago as the summer of 1831, demonstrated the safety, certainty, and facility, which would arise in rock-blasting, whether under water or otherwise, from a resort to galvanic apparatus as the means of igniting the gunpowder employed. His efforts had been incited originally by those of a person named Shaw, who had procured a patent for employing mechanical electricity for the purpose; but who, finding that method of operating too precarious to be useful, had applied to Dr. Hare to acquire a knowledge of more effectual means. This led to the experiments of which the result has been published, both in the newspapers, and in the Journal of the Franklin Institute. The subject was now referred to, in consequence of the recent publication of analogous experiments by his friend, Prof. Daniell, of King's College, London, who, in the case in point, no doubt as in that in which he had "*reinvented*" Dr. Hare's concentric blowpipe, was ignorant of the results previously obtained in this country. Prof. Daniell had, in blasting, used the highly ingenious appa-

ratus known as "*Daniell's sustaining battery,*" the contrivance of which had done him great honor; but Dr. Hare conceived that however preferable might be a battery of that kind, in processes requiring a permanent current; for a transient energetic ignition, such as is most suitable for blasting, the calorimotors which he had contrived, would be decidedly more efficacious.

Dr. Hare further communicated the results of his recent experiments to obtain calcium, as follows:

By igniting an equivalent weight of lime with an equivalent and a half of crystallized bicyanide of mercury, in two successive experiments, residual masses were obtained, which, within a small fraction, had the weight which would have resulted from the union of an equivalent of calcium, with an equivalent of cyanogen. A portion of the compound thus made, was placed between electrodes of charcoal, the lower piece being excavated slightly to receive it, and the upper one being so shaped as to enter the cavity. The electrodes were severally supported by copper rods passing through stuffing boxes, so as to be included within a glass receiver, ground to fit air tight upon an extra air-pump plate. In consequence of this arrangement, the receiver could be exhausted of air, and the electrodes consequently situated in vacuo, or in an atmosphere of hydrogen, as might be deemed preferable. The lower electrode formed the cathode, the upper the anode, of two hundred pairs, each comprising one hundred square inches of zinc surface. Under these circumstances, when the circuit was completed, by throwing the usual charge of acid upon the plates, the most intense ignition ensued. The supposed compound of cyanogen appears to be an excellent conductor, and nothing could exceed the splendor of the purple light emitted during its deflagration. It was too vivid, however, for more than a transient endurance by an eye unprotected by deep colored glasses. After the compound was adjudged to be sufficiently deflagrated, and time had been allowed for refrigeration, on lifting the receiver, masses were found upon the coal which had a metallic appearance, and which, when moistened, produced an effluvium, of which the smell was like that which had been observed to be generated under like circumstances, by the siliciuret of potassium.

Similar results had been attained by the deflagration, in a like manner, of a compound procured by passing cyanogen over quicklime, enclosed in a porcelain tube heated to incandescence.

Phosphuret of calcium, when carefully prepared, and subsequently well heated, was found to be an excellent conductor of the voltaic current, evolved from the apparatus above mentioned. Hence it was thought expedient to expose it in the circuit of the deflagrator, both

in an atmosphere of hydrogen, and in vacuo. The volatilization of phosphorus was so copious as to coat throughout the inner surface of the glass receiver, with an opake film, in color resembling that of the oxide of phosphorus, generated by exposing this substance under hot water, to a current of oxygen.

The phosphuret at first contracted in bulk, and finally was for the most part volatilized. On the surface of the charcoal adjoining the cavity in which the phosphuret had been deflagrated, there was a light pulverulent matter, which, thrown into water, effervesced, and when rubbed upon a porcelain tile, appeared to contain metallic spangles, which were oxidized by the consequent exposure to atmospheric oxygen.

In one of Dr. Hare's experiments with the apparatus described, portions of the carbon forming the anode appeared to have undergone complete fusion, and to have dropped in globules upon the cathode.

When rubbed, these globules had the color and lustre of plumbago, and by friction on paper, left traces resembling those produced by that substance. They were susceptible of reaction with chlorohydric or nitric acid, or with aqua regia. They were not, in the slightest degree, magnetic.

About 1822, Professor Silliman had obtained globules which were by him considered as fused carbon, by others were deemed to be depositions of carbon carried from one electrode to the other. Professor Silliman had at that time sent Dr. Hare several nodules for examination, of which none, agreeably to his recollection, appeared so much like products of fusion as those lately obtained.

Formerly, plumbago had been considered as a carburet of iron, but latterly, agreeable to the high authority of Berzelius, should be viewed as carbon holding iron in a state of mixture, and not in that of chemical combination. It would not then be surprising, if the globules in question furnished an instance of the conversion of charcoal into plumbago.

Since the above mentioned experiments were made, Dr. Hare has had reason to believe that the compound obtained as above described, by heating lime with bicyanide of mercury, contains fulminic acid, or an analogous substance. The compound being dissolved in acetic acid, and the filtered solution subjected to nitrate of mercury, a copious white precipitate resulted. This being desiccated, proves to be a fulminating powder. It explodes between a hammer and anvil like fulminating mercury, or rather with the sharp sound of fulminating silver.

Dr. Hays made a verbal communication of a case of the application of the catoptric method of examining the eye, by which he had de-

tected the destruction of the lens and of its capsule, under circumstances which would not otherwise have led to the conclusion that they had been destroyed, and where vision had been obtained by the use of a cataract lens.

June 21, 1839.—The librarian was authorized to take order in relation to an exchange of the Transactions of the Society, for the Journal of the Boston Natural History Society.

The committee on the letters of Mr. J. P. Hulliken and Dr. Townsend reported, and was discharged.

The committee to whom was referred the publication of certain meteorological tables, accidentally omitted in their place in the Transactions, and the journal of Dr. Thomas Hewson, reported in favor of the publication of certain of the former and of the latter.

Dr. Bache presented a translation of an obituary notice of Professor Rask of Copenhagen, late a member of the Society, to be deposited in the archives of the Society.

Mr. Vaughan informed the Society of the decease of Doctor Thomas Cooper, a member of the Society, who died on the eleventh of May last.

Dr. Hays communicated verbally the case of a woman laboring under an affection of the optic nerve, in which a defect in the recognition of colors was developed, according to her statement, at the same time with the affection of the general vision, and in which a partial recovery of the power of vision had been attended with the recovery of the power to distinguish colors.

Dr. Hare laid before the Society, portions of barium, strontium and calcium, and stated the considerations which led him to attempt their extrication, and the means by which he had succeeded.

July 17, 1839.—The Committee on the observations of the Solar Eclipse of May 14–15, 1836, reported, and their report was ordered for publication.

The American observations, twenty eight in number, were given at length. At the invitation of Mr. C. Rumker, Director of the Hamburg Observatory, conveyed through Prof. A. D. Bache, twenty one of these observations had been forwarded by Mr. John Vaughan to that distinguished astronomer, for comparison with those which had been made in Europe. The report contained a letter from Mr. Rumker, in which the time of ecliptic conjunction, with its variations for the small errors of the tables, was deduced from each of the European and American observations. Mr. Rumker remarks, that the corrections of this time for the corrections of the moon's declination and parallax, appearing with opposite signs in the observations on the two continents, afford unusual facilities for determining these corrections, par-

ticularly the latter. Mr. Rumker's letter not having given the final results deducible from his equations of condition, the committee appended a letter from Mr. Sears C. Walker, in which he deduces from Mr. Rumker's equations, the following corrections of the solar and lunar elements given in the Nautical Almanac.

$d\ (\odot + \mathbb{C}) = -2''.279 =$ correction of sum of semidiameters.
$d\ (\odot - \mathbb{C}) = -1''.750 =$ " difference of semidiameters.
$d\ \beta = -6''.736 =$ " moon's latitude.
$d\ \pi = +1''.516 =$ " moon's parallax.
$d\ \lambda = -2''.276 =$ " moon's longitude.

These corrections being referred to the moon's orbit and its secondaries, give, after Bessel's notation (Astr. Nachr. 320)

$\imath = -2''.934 =$ cor. moon's place in true orbit.
$\zeta = -7''.198 =$ " on secondary to do.

Mr. Peters, (Astr. Nachr. 326) without the American observations, had obtained

$\imath = -3''.650.$
$\zeta = -5''.472.$

Mr. Walker having previously reduced the American observations with Peters's co-ordinates and corrections, furnishes a comparison of the longitudes from Greenwich, derived by different computers from this eclipse.

	Walker from Rumker's equations.			Walker from Peters's co-ordinates.		
	h.	m.	s.	h.	m.	s.
Washington, (Capitol,) - - - - - - -	5	8	13.83	5	8	13.45
Haverford School, Delaware Co., Pa. - - -	5	1	16.53	5	1	15.05
Germantown, C. Wister's private Observatory, - -	5	0	40.61	5	0	40.94
Philadelphia, (State House,) - - - - -	5	0	38.89	5	0	39.60
West Hills, (Coast Survey,) - - - - - -	4	53	41.11	4	53	42.05
Southwick, Mass., A. Holcomb's p. Obs. - -	4	51	12.89	4	51	13.25
Providence, Brown University, - - - -	not reduced.			4	45	38.33
Dorchester, Mass., Wm. C. Bond's p. Obs. - -	"			4	44	16.92

Mr. Walker finds from the resolution of Rumker's equations of condition, + 1″.516 for the correction of Burkhardt's constant of the moon's equatorial parallax. In the Memoirs of the Astronomical Society, Vol. x, Mr. Henderson gives + 1″.5 as the value of this correction, derived from Plana's *Théorie de la Lune*, and + 1″.3 as the value of the same, derived from a discussion of all the meridian observations of the moon made in 1832 and 1833, with the mural circles at Greenwich, Cambridge, and the Cape of Good Hope. This correction had hitherto been derived chiefly from theory and meridian observations. It is seldom that an eclipse or occultation has been so extensively observed as to furnish a determination of this element. In the present instance, the results by the three independent methods, present a close agreement.

Dr. Chapman, one of the Vice Presidents of the Society, stated that he had received a letter from the Prince of Musignano, informing him

that a meeting of the scientific men of Italy would be held at Pisa, in Oct. next, and inviting the Society to send a delegate to the meeting.

Dr. Patterson communicated the decease of Mr. Francis Nichols, a member of the Society, on the 7th of July.

Dr. Bache also announced the decease of Dr. John Newnam, formerly of Salisbury, N. Carolina, a member of the Society.

The following candidates were declared duly elected members of the Society:—

Theod. Romeyn Beck, M. D., of Albany.

Richard C. Taylor, of Philadelphia.

August 16, 1839.—A communication from the foreign Secretary of the Royal Society of London, in relation to magnetic observations was referred to the astronomical committee.

Dr. Dunglison described the appearances which he had witnessed, in company with Professor Silliman, after the tornado of the 31st ultimo, at New Haven. The evidences appeared to him to favor the idea of a gyratory motion. The direction of the storm was from south-west to north-east.

Mr. Justice described a similar tornado which had occurred on the same day, fifteen miles north of Philadelphia, showing evidence, in his opinion, of a similar movement of gyration.

2. *Proceedings of the Boston Society of Natural History. Compiled from the records of the Society, by* Jeffries Wyman, M. D., *Recording Secretary.*

June 5, 1839.—J. E. Teschemacher, Esq. in the chair.

Dr. A. A. Gould read a communication from Prof. C. B. Adams, giving the description of a shell found at East Boston, and called by him *Delphinula minor*; it was not referred to the genus *Delphinula*, however, without some hesitation. Dr. Gould having made a more extended examination was induced to consider it as identical with Helix corpuloides, Montagu; and that it came under Brown's new genus *Delphinoidea.*

Mr. T. J. Whittemore read a report on the specimens of *Planorbis corpulentus* presented to the society by Prof. C. B. Adams. They were collected from the Otter Creek, Middlebury Vt., and the species is described in the appendix to Long's second expedition. The *corpulentus* is closely allied to the *trivolvis*. The former however is much less rounded on the sides of the whorls; carinæ are more prominent and the upper side is much more flattened horizontally; the shell is larger and higher in proportion to its width, and the aperture extends both above and below its penultimate whorl.—Habitat, in shal-

low and quiet water on rocks, to which it adheres in an erect position, the plane of the aperture being the base.

Mr. J. E. Teschemacher presented a specimen of *Elvella esculenta* from Oak Island. This is much esteemed as an article of food, and at certain seasons of the year is in great demand in the London market; it is not however so rich or so highly esteemed as the *truffle*. He also exhibited a specimen of *yellow Trillium*, received from Mr. R. H. Gardiner, of Gardiner, Me.; this was first noticed by Dr. C. T. Jackson, and afterwards was procured by Mr. G. He also exhibited a new variety of the *Marchantia*, probably the *triceps* of Hitchcock's catalogue.

Mr. T. made a few remarks on the report of the surveyors of the State of N. York. He thought that besides giving descriptions of the actual state of things, they should also institute comparisons between them and similar appearances in other countries. Comparative information was extremely valuable in an agricultural or an arboricultural point of view, especially as to the importance or profit of different growths of timber; the same remarks might be applied to the botany of different countries.

June 19, 1839.—G. B. Emerson, Esq., President, in the chair.

Mr. J. E. Teschemacher read a report on the minerals found at the *sienite quarry*, at Milk row, in Charlestown. *Prehnite* is found there, varying in color from pure translucent and opake white, to fine apple green; some specimens are as dark and brilliant as the finest *Chrysoprase*. The crystals consist for the most part of aggregated groups with curvilinear faces. In one instance the form of aggregation was elliptical, imbedded in carbonate of lime. There are also crystals of the primary form, a right rhombic prism; the measurements by the goniometer were as follows; M or M′ on *f* 139° 45′; M on M′ 101° 05′; according to Phillips the last is 100°; the result stated however was procured from repeated observations. *Quartz* is met with in nodules and crystals; the latter small, but of the purest water, occasionally rising from the midst of pure green *prehnite;* in some the modifications *n*, *h*, 1, 2, and *i*, 1, 2 are visible. *Feldspar;* this is generally in a state of decomposition, which appears to commence from the centre. In one specimen the prism was coated with bright green *crystallized chlorite*, interspersed with small masses of pure white and nearly transparent curvilinear prehnite. *Hornblende* is found in form of oblique rhombic prism with modifications C, K, *l*; crystals are small and black on white prehnite. *Epidote* is found in minute dark green crystals with the usual terminations. *Carbonate of lime* occurs in small crystals with modifications resembling dog tooth spar; also in the form of the primary rhomb half an inch in

length. In one specimen the carbonate rested on green prehnite; decomposition, indicated by the deep striæ in the lines of cleavage, had apparently commenced in the lime, and had been subsequently arrested, crystallization recommencing, as the sharp edges produced by decomposition were covered with an infinite number of minute crystals. Another specimen assumed the form of a nodule six inches in diameter, bearing a strong resemblance to the carbonate of iron. *Stilbite* is found in cavities of prehnite, assuming the form of the rhombic prism without modifications; also with the modification *a* and *c*. *Chabasie*, on prehnite, of a rhomboidal form is met with, measuring 94° 46′ and 85° 40′, generally of an opaque milk white color, and one sixteenth of an inch in size. *Laumonite*, abundant. Other minerals had been found which he had not been able to determine.

July 3, 1839.—C. K. Dillaway, Esq., in the chair.

Dr. D. H. Storer exhibited living specimens of male and female *Syngnathus*. He stated that numerous males had been taken in this vicinity during the present season, in all of which there existed a pouch on the abdomen, posterior to the anus, in which were numerous ova; these last were hatched in the course of twenty four hours after they were taken. The females were subsequently found and recognized by the existence of ovaries. The female deposits the ova in the pouch of the male, where they remain until hatched.

July 17, 1839.—Dr. A. A. Gould, in the chair.

Dr. D. H. Storer stated that since the last meeting he had had an opportunity of seeing a large specimen of the *Carcharias obscurus* of Le Sueur, taken off Nahant. This specimen was about nine feet long, and weighed 800 or 900 pounds. There were six or seven rows of well formed teeth, but only one row above and two below had as yet made their appearance through the lining membrane of the mouth; all the teeth were serrated.

Dr. S. also exhibited a specimen of *Emys Blandingii* of Holbrook, taken in Haverhill in this state. The only localities heretofore known were the prairies in Illinois and the territory of Ouisconsin, where they are said to be abundant. This species belongs to the section Hiantes, (Dum. and Bibron,) being unable perfectly to close the shell.

Dr. T. M. Brewer stated that considerable doubt existed with regard to the color and configuration of the eggs of the *Chicadee*. He had during the last week received two specimens which were small, oval, and uniformly speckled with red spots.

Mr. J. E. Teschemacher exhibited specimens of the following plants brought from the Blackstone river, by Mr. F. A. Eddy, a member of the society.—*Scirpus sylvaticus* of Lin., Willd., Vahl, Hooker,

De Cand. and J. E. Smith; it grows in moist and shady woods, and on banks of rivers; pretty common in Scotland, less frequent in England; root is creeping; plant grows a yard high or more, smooth; leaves grassy and flat, rough, cutting on the edges and keel. Panicle consists of innumerable little dark green, ovate spikes; glumes obtuse with more or less of a small point: stigma 3-fid; seed lenticular, whitish, smooth with six or eight rough bristles. We have many Scirpi which are unknown in Europe. Sir J. E. Smith only names three which are unknown here, viz. S. setaceus, holoschemus and sylvaticus.

Mr. T. also exhibited a specimen of the *Andromeda mariana* from the same locality; also the rarest of our American plants, Lygodium palmatum. A curious variety of *Linaria vulgaris* (the *Peloria* of Lin.) was exhibited; the corolla appears in the form of a cone, terminated above by a prominent border of five divisions, and below producing five spurs instead of one; so that according to Nuttall we have the ringent flower restored to its natural symmetry and regularity, this being the original condition of the flower, an opinion, however, which is not substantiated.

Dr. A. A. Gould read descriptions of the following species of shells.

Solecurtus nitidus. Testâ oblongo-ovatâ; utrinque rotundatâ, inequilaterali; epidermide inflectâ, luteo-virescente, glabrâ, postice corrugatâ; intus costâ transversali. Long. 3 poll. Alt. $1\frac{3}{10}$. Lat. $\frac{7}{10}$.

Mactra ovalis. Testâ magnâ, crassâ, obovatâ, subtriangulari, subequilaterali; epidermide rudi, fusco-viridi, transverse corrugatâ indutâ; natibus, areolâ lanceolatâ. Long. 4 poll. Alt. $2\frac{7}{10}$. Lat. $1\frac{9}{10}$.

Bulla debilis. Testâ parvâ, convolutâ, ovatâ, ventricosâ, hyalinâ, basi truncatâ, sub-umbilicatâ; spirâ retusâ, discoideâ; anfractibus quatuor, suprâ rotundatis. Long. $\frac{5}{10}$. Lat. $\frac{4}{10}$.

Bulla obstricta. Testâ parvâ, pallidâ, convolutâ, ovoideâ, medio obstrictâ; anfractibus quinque, spirâ elevatâ, obtusâ; suturâ duplicatâ; aperturâ longitudinali, inferne dilatatâ. Long. $\frac{7}{10}$ poll. Lat. $\frac{4}{10}$.

Lymnea chalybea. Testâ ovatâ, anfractibus quatuor; spirâ acutâ; suturâ profundâ; aperturâ magnâ, dilatatâ; intus chalybeâ, extra nigricante. Long. $\frac{7}{10}$ poll. Lat. $\frac{7}{20}$ poll.

Valvata pupoidea. Testâ parvâ, castaneâ, elevatâ: anfractibus quatuor ad quinque, ultimâ a precedente disjunctâ. Long. $\frac{1}{10}$ poll. Lat. $\frac{3}{40}$ poll.

Planorbis hirsutus. Testâ dextrorsâ, discoideâ, utrimque concavâ; anfractibus quatuor, lineis hirsutis, volventibus insignibus. Lat. $\frac{4}{20}$ poll. Long. $\frac{1}{20}$.

Natica flava. Testâ ventricoso-globosâ, imperforatâ, albâ, epidermide flavâ; anfractibus quatuor; columellâ flexuosâ; aperturâ amplâ. Long. 1 poll. Lat. $\frac{8}{10}$ poll.

NATICA CANALICULATA. Testâ ovato-conicâ, ponderosâ; spirâ retusâ: anfractibus quatuor, superne subcarinatis; suturâ profundé impressâ; aperturâ semilunari; umbilico parvo, lineari. Long. $1\frac{1}{10}$ poll. Lat. $\frac{7}{10}$ poll.

LACUNA NERITOIDEA. Testâ ovato-globosâ, tenui, lævi, flavescente, epidermide scabrâ; anfractibus tribus convexis, ultimo magno; spirâ fere nullâ; aperturâ obliquâ, semilunari; umbilico profundo. Long. $\frac{1}{2}$ poll. Lat. $\frac{1}{4}$ poll.

FUSUS SCALARIFORMIS. Testâ fusiformi, albâ vel castaneâ, longitudinaliter 15 ad 20 lamelloso-costatâ; caudâ longiusculâ; aperturâ spiram æquante. Long. $1\frac{3}{4}$ poll. Lat. $\frac{4}{5}$ poll.

FUSUS TORNATUS. Testâ ovato-conicâ, antiquatâ, pallide corneâ; anfractibus sex vel septem convexis, costis tribus obsoletis, castaneis cinctis; aperturâ rotundatâ, evasâ, spiram æquante; canali brevi, valdé recurvâ. Long. $2\frac{3}{4}$ poll. Lat. 2 poll.

BUCCINUM ROSACEUM. Testâ parvâ, conico-acutâ, albâ, rosaceo-tinctâ; anfractibus sex, plano-convexis, spiraliter lineolatis; aperturâ spirâ breviore; columellâ arcuatâ, planulatâ. Long. $\frac{3}{10}$ poll. Lat. $\frac{3}{20}$ poll.

Dr. J. WYMAN exhibited the intestine of a *mackerel shark*, (Lamna punctata, Mitchill,) showing the ducts of the pancreas and liver, the spiral valve formed by the mucous membrane of the intestine, a communication between the cavity of the peritoneum and anus by means of two small canals, and an opening in the lower part of the intestine communicating with a hollow organ, on which commenced the first branches of the vena cava.

August 7, 1839.—Dr. J. B. S. JACKSON, in the chair.

Dr. J. WYMAN made a written report on the *electrical eel*, (Gymnotus electricus, Lin.) exhibiting dissections of the electrical organs, and of the nerves by which they are supplied; he also gave an account of the physical and physiological properties of the electricity developed by this fish, and showed the analogy between it and common electricity.

Dr. D. H. STORER read a communication from Mr. J. G. Anthony of Cincinnati, giving a description of the two following new species of shells; viz. Helix striatella and Paludina Cincinnatiensis.

Dr. S. also gave an account of an *elephant* shark (Squalus elephas, Le Sueur) taken near Provincetown, Mass., measuring 30 ft. in length.

Mr. J. E. TESCHEMACHER exhibited some fossil corals and madrepores in limestone, from Devonshire, England, beautifully ground and polished; also some photogenic drawings of plants, feathers, &c., copied from nature.

Sept. 4, 1839.—Amos Binney, Vice President, in the chair.

Dr. C. T. Jackson gave an analysis of the *serpentine marble* from Vermont. This mineral is harder than common serpentine or feldspar. The result of analysis is as follows:

Water, - - - - - -	7.70
Silica, - - - - - -	45.80
Magnetic Iron, - - - - -	2.00
Magnesia, - - - - -	33.44
Protoxide of Iron, - - -	7.60
Oxide of Chrome, - - -	2.00
Loss, - - - - - -	1.46
	100.00

Dr. Jackson also gave an analysis* of a new mineral obtained from Chessy, France, which was supposed to be a hydrate of copper; analysis however proved it to be a crenate of copper instead of the hydrate. For this mineral, he proposed the name of Beaumontite, in honor of M. Elie de Beaumont, the distinguished French geologist. He also exhibited specimens in which *crenic* and *apocrenic* acid were combined with metallic bases. Crystals of *crenic acid* were also exhibited; these were obtained by dissolving the acid in alcohol, and evaporating to dryness in the sun.

Dr. Jackson then read a communication addressed to him by Mr. George Catlin, giving an account of his visit to the Côteau des Prairies, the locality from whence is obtained the Indian "pipe stone."†

3. *Reports on the Shells and Minerals presented by Dr. Brinckerhoff to the New York Lyceum of Natural History.*‡

The subscriber, who was appointed to examine and report upon certain shells forming part of the valuable specimens of natural history presented

* For the analysis of this mineral, see last number of this Journal, p. 398.

† See the letter, page 138 of this No.

‡ *To the Editors of the Am. Jour. Science and Arts.*—In the month of July last, Dr. Brinckerhoff, of the U. S. ship North Carolina, presented to the Lyceum of Natural History of this city, a large and valuable collection of specimens in natural history, collected by him during the recent voyage of this ship. These specimens consisted of various *mammalia*, birds, reptiles, *mollusca* and *crustacea*, numerous tropical plants and seeds, with many interesting geological and mineralogical specimens. They were deemed of sufficient interest and importance to be referred to special committees for examination and report. The only full reports which have yet been made, are those upon the mineralogical specimens, and upon the mollusca. As there is no immediate prospect of a continuation of our "Annals," we have thought the best use we could make of these reports would be to offer them for publication in your Journal. Yours most respectfully,

John H. Redfield, *Cor. Sec. N. Y. L. N. H.*

New York, November 19th, 1839.

to the Lyceum by Doctor Brinckerhoff, of the U. S. Navy, respectfully reports, that the shells thus referred to him consist of *Annulata, Cirrhipeda, Conchifera* and *Mollusca*, and are found to be as follows:

Annulata, 4 genera, viz.

1. Dentalium politum, Linn.
2. Sabellaria, 1 species, ?
3. Spirorbis, 1 do. ?
4. Serpula, 2 do. ?

Cirrhipeda, 7 genera, viz.

1. Tubicinella Balænarum, Lam.
2. Coronula Balænaris, Lam.
   ——— diadema, "
   ——— Testudinaria, "
3. Balanus tintinnabulum, Brug.
   ——— ——— ?
4. Anatifa lævis, Lam.
5. Pollicipes mitella, Lam.
6. Cineras vittata, Lam.
7. Otion Cuvieri, Lam.

Conchifera, 22 genera, viz.

1. Solen Dombeii, Lam.
2. Amphidesma solidum, Gray.
3. Mesodesma donacia, Desh.
4. Saxicava pholadis, Lam.
5. Petricola ochroleuca, Lam.
6. Tellina sulphurea, Lam.
   ——— scobinata, Linn.
7. Capsa Brasiliensis, Lam.
8. Cytherea impudica, Lam.
   ——— meretrix, Lam.
   ——— Dione, Lam.
   ——— flexuosa, Lam.
   ——— castanea, Lam.
9. Venus corbis, Lam.
   ——— Peruviana, Linn.
10. Cardium unedo, Linn.
11. Cardita.
    ———
12. Hiatella arctica, Lam.
13. Isocardia Moltkiana, Born.
14. Arca scapha, Lam.
    ——— rhombea, Born.
    ——— senilis, Linn.
15. Modiola discors, Lam.
    ——— caudigera, Lam.
16. Mytilus bilocularis, Lam.
    ——— smaragdinus, Chemn.
17. Meleagrina margaritifera, Lam.
18. Pecten purpuratus, Lam.
19. Plicatula cristata, Lam.
20. Spondylus maximus, Gualt.
21. Ostrea cornucopiæ, Lam.
22. Orbicula lamellosa, Brod.

Mollusca, 50 genera, viz.

1. Chiton elegans, Frembl.
   ——— olivaceus, Frembl.
   ——— Cumingii, Frembl.
   ——— spinosus, Brug.
   ——— Barnesii, Gray.
2. Patella lævigata, Chemn.
   ——— saccharina, Linn.
   ——— striata, Petit.
   ——— tessellata, Mull.
   ——— Testudinaria, Linn.
   ——— ——— ?
3. Siphonaria gigas, Sowb.
   ——— Lessonii, Blain.
4. Fissurella biradiata, Frembl.
   ——— grandis, Sowb.
   ——— oriens, Sowb.
   ——— Panamensis, Sowb.
5. Hipponix barbata, Sowb.
6. Calyptrea radians, Desh.
   ——— rugosa, Desh.
   ——— spinosa, Sowb.
   ——— tectum sinense, Lam.
7. Crepidula foliacea, Brod.
   ——— fornicata, Lam.
   ——— squamosa, Brod.

8. Bulla ampulla, Linn.
9. Helix Peruviana, Lam.
   ——— melanotragus, Born.
10. Bulimus Gravesii, King.
   ——— Leuzonicus, Sowb.
   ——— undatus, Brug.
11. Partula hyalina, Brod.
12. Neritina zebra, Lam.
   ——— picta, Sowb.
   ——— caffra, Gray.
13. Nerita textilis, Gray.
   ——— polita, Linn.
14. Natica glaucina, Lam.
   ——— glauca, Humb.
15. Janthina communis, Lam.
   ——— exigua, Lam.
16. Sigaretus haliotoideus, Lam.
17. Haliotis Cracherodii, Linn.
   ——— striata, Linn.
18. Solarium granulatum, Lam.
19. Trochus ater, Lesson.
20. Monodonta fragarioides, Lam.
   ——— pagodus, Lam.
   ——— viridis, Lam.
21. Turbo petholatus, Linn.
   ——— torquatus, Lam.
   ——— cornutus, Gmel.
22. Phasianella Peruviana, Lam.
   ——— ——— ?
23. Turritella replicata, Lam.
   ——— fuscata, Lam.
24. Cerithium aluco, Brug.
   ——— nodulosum, Brug.
   ——— tuberculatum, Lam.
25. Pleurotoma virgo, Lam.
26. Turbinella rhinoceros, Lam.
   ——— pugillaris, Lam.
27. Cancellaria cancellata, Lam.
   ——— decussata, Sowb.
28. Fasciolaria aurantiaca, Lam.
29. Fusus incrassatus, Lam.
   ——— longissimus, Lam.
30. Pyrula ventricosa, Sowb.
31. Ranella ventricosa, Brod.
   ——— granifera, Lam.
32. Murex radix, Lam.
   ——— regius, Swains.
   ——— crassilabrum, Gray.
   ——— ramosus, Linn.
33. Triton canaliferum, Lam.
   ——— tuberosum, Lam.
34. Rostellaria curvirostris, Lam.
35. Strombus canarium, Linn.
   ——— gibberulus, Linn.
   ——— granulatus, Wood.
   ——— auris Dianæ, Linn.
   ——— floridus, Lam.
36. Cassis rufa, Brug.
   ——— vibex, Brug.
   ——— sulcosum, Brug.
37. Ricinula tuberculata, Blain.
38. Purpura armigera, Lam.
   ——— patula, Lam.
   ——— planospira, Lam.
   ——— chocolatum, Duclos.
   ——— columellaris, Lam.
   ——— Riosquiformis, Duclos.
   ——— hippocastanum, Lam.
   ——— angulifera, Duclos.
39. Concholepas Peruviana, Lam.
40. Buccinum annulatum, Lam.
   ——— Gayii, Kiener.
   ——— inflatum, Lam.
41. Terebra ——— ?
42. Columbella mercatoria, Lam.
   ——— mendicaria, Lam.
43. Mitra pontificalis, Lam.
   ——— tæniata, Lam.
44. Marginella Bellangeri, Kiener.
45. Ovula birostris, Sowb.
46. Cypræa Testudinaria, Linn.
   ——— Mauritiana, Linn.
   ——— Argus, Linn.
   ——— pustulata, Lam.
   ——— obvelata, Lam.
   ——— coccinella, Linn.

47. Terebellum subulatum, Lam.
48. Ancillaria castanea, Sowb.
——— cinnamomea, Lam.
49. Oliva hiatula, Lam.
——— Senegalensis, Lam.
——— episcopalis, Lam.
——— ispidula, Lam.
50. Conus litteratus, Gmel.
——— lividus, Brug.

Conus imperialis, Linn.
——— betulinus, Linn.
——— textile, Linn.
——— tulipa, Linn.
——— terebra, Brug.
——— stercus muscarum, Gmel.
——— canonicus, Brug.
——— sponsalis, Chemn.

The above mentioned shells are generally in good order and preservation. They are principally from Mazatlan, St. Lorenzo, Guayaquil, Callao, Valparaiso, and the Sandwich and Society islands; a few are from the Atlantic coast of South America.

Doctor Brinckerhoff has also with much pains procured several of these species containing the animal, and preserved them in spirits of wine. These, as well as various fruits, seeds, animals, &c. &c., have been carefully divided and placed in separate jars. Among the more rare specimens, may be noticed the Marginella Bellangeri, Kiener, from Bahia, the Cypræa Testudinaria, the Ancillaria cinnamomea, the clusters of the Orbicula lamellosa, Brod., from Valparaiso, and the Purpura planospira.

The entire collection is one of the most valuable in this department ever presented to the Lyceum, embracing more than two hundred species; of nearly one half of which there were no specimens in our museum. It has been made by a gentleman attached to the navy, in the intervals of his official duties and during a single cruise. By it he has well deserved not only the thanks he has already received from this institution, but those of every lover of science and useful knowledge. His example and that of several others show how much may be accomplished by the naval officers if a similar zeal shall become general among them. By collecting and bringing home the natural productions of the lands and oceans that they visit, they may employ the leisure which their profession sometimes affords, in an occupation at once useful and interesting; enlarge the boundaries of science, and add new claims to the many they already possess to the esteem and admiration of their countrymen.

The subscriber suggests the propriety of publishing the several reports upon the specimens presented by Dr. Brinckerhoff in such manner as the Society may think expedient. JOHN C. JAY.

New York, October, 1839.

Report upon the Minerals, Geological Specimens and Fossils, from the island of St. Lorenzo, presented to the New York Lyceum of Natural History, by Dr. Brinckerhoff, and referred to Jos. Delafield.

Selenite, in detached crystals and in fasciculated groups, imbedded in dark red and brown indurated clay.

Calcareous Spar, white, massive, from a vein of the same in one of the rock strata of the island.

Galena.

Asphaltum.

Ferruginous Clay.

Saline Sandstone, assuming singular configurations, cellular, cavernous, and sometimes botryoidal. The forms seem to be derived from the accidental solution of the salt, and wasting away of the sandstone irregularly.

One triangular specimen of saline sandstone is in the form of an irregular tetrahedron, the two axes being unequal. The planes are wasted away, and the solid angles not, so that a continuation of the same process would leave a cellular substance like the others, but regular. This form is said to be the most common, and although it is not decidedly a crystal, the tendency of its component parts to crystallize and the symmetry of this specimen, increase the probability that it is. Further specimens and observations are desirable, and the observer should be acquainted with the sandstone of Fontainbleau, which suggests itself as analogous in some respects.

The geological specimens from the same island are compact ***Quartz rock*** from the summit, ***Basaltiform rock***, but its identity with basalt is doubtful; the forms are the chief resemblance in the specimens exhibited, which specimens are argillaceous and ferruginous. Their exposure to the weather and contact with other mineral substances, may have caused some change; and as basalt is sometimes liable to decomposition, it is probable that the specimens are from a formation of true basalt.

Striped or Variegated Sandstones.

Light Colored Clay Slate.

Dark Red Ferruginous Clay.

Graywacke.

Coal has lately been discovered on the island, and fossils are contained in some of the rock strata, so that this little island offers to the geologist in its numerous strata of rocks, with their accompanying minerals and fossils, a more varied field for observation than is usual in so small a space. The committee cannot give the desired geological description for the want of other facts, but hopes to obtain them.

The fossils consist of small bivalves in the clay slate.

Trigonia in graywacke, and casts of Trigonia in the red clay.

Ammonites and casts of ammonites, and some small Isocardia.

Dr. Brinckerhoff has also collected a variety of the rolled pebbles of the beach. They are principally porphyries of different colors, the feldspar crystals being smaller and generally white; siliceous pebbles and common jaspers.

4. *Further account of the Shooting Stars of Aug.* 9 *and* 10, 1839.

1. *Columbia, Tenn., N. lat.* 35° 36′; *W. lon.* 87°.—Mr. Thomas R. Dutton has communicated to me the following observations made on the night of August 9, 1839. "From 0h. 41m. A. M. (Aug. 10,) to 1h. 31m., I saw 45 shooting stars; three fourths of these proceeded from a radiant; about one fourth had trains. From 2h. 36m. to 3h. 6m. I saw 35; from 3h. 6m. to 3h. 36m. I saw 20. Of those which had trains, scarcely one moved in an unconformable direction: of those seen from 2h. 36m. to 3h. 6m. about three fourths left trains behind them, and five sixths of them obeyed the radiant. The meteors were not as large or as brilliant as those of last year, but resembled them in other particulars. I observed the progression of the radiating point noticed last year by Mr. Schaeffer." (This Journal, Vol. xxxv, p. 169.)

2. At *Tunbridge Wells, (Eng.)* N. lat. 51° 7′; E. lon. 15′, "Prof. Powell saw on the 10th of August, 1839, a very brilliant exhibition of meteoric stars: they averaged from 15 to 20 in the quarter of an hour: they all left trains of light after them: the motion of all was from N. toward the S." *Lond. Athenæum, Aug.* 31, 1839, p. 657.

3. At *Brandsbury House, about* 3 *miles N. W. of London.* Edward Cooper, Esq., aided by Messrs. Jones and Fenton, observed during 3h. 22m. on the night of Aug. 10, 1839. The sky was at times partially overcast. "The average number of meteors observed in the half hemisphere to which we attended, was 44. Three or four were very splendid, but none equal to the finest seen Aug. 10, 1838, at Geneva. The general result however fully establishes the fact that the nights of the 10th or 11th of August, furnish a most remarkable exhibition of these interesting celestial travellers." *Extract from a paper by Mr. Cooper, in* Lond. and Ed. Phil. Mag., *Nov.* 1839, p. 372.

4. *Breslau.* N. lat. 51° 6½′; E. lon. 17° 2′. The St. James's Chronicle, of London, Sept. 5, 1839, contains a translation of an account published by Von Boguslawski in the Prussian State Gazette, of meteoric observations, at the August epoch, made under his superintendence. The following is an abstract of the account. "For several days previous to August 10, 1839, the sky was overcast. The night of the 10th was clear, and at dusk, it was evident that an unusual fall of meteors had begun. Arrangements were made for observing the numbers, times, durations, magnitudes, courses, &c. of the meteors. These however were not completed until 9h. 26m. P. M., when all the observers, fifteen in number, were assembled. Eleven (?) were stationed at the six windows of the Observatory, and four at the clocks. In the course of 5h. 48m. ending at 3h. 14m. (A. M. of the 11th, when daylight interfered,) they noticed *one thousand and eight shoot-*

ing stars,—not including numbers which must have been overlooked, because the observers were not sufficiently numerous. Sometimes the stars succeeded each other so rapidly that nothing but the *time* could be noted. The courses therefore of only 977 were marked upon the star-maps, with all their circumstances. The following result is as near the truth as possible. Five meteors appeared as bright as Venus; 14 as Jupiter; 238 as stars of the first magnitude; 354 of the second, and 257 of the third magnitude: 101 were reckoned smaller still, and the magnitudes of eight were lost in the hurry. Two hundred and seventy three left luminous trains. * * Three observers watched on the night of the 11th, and saw 323 shooting stars, while the sky was partly covered. On the night of the 12th, one observer counted 103 meteors, between 10 P. M. and 1h. 45m. A. M. of the 13th. "Therefore, the annual periodical return of an uncommon fall of stars towards the 10th of August, is once more confirmed, as well as that the passage of this host of meteors near the earth, lasts several days."

It thus appears that on the night of August 10th, 1839, meteors were seen as abundantly at Breslau as at New Haven. (This Jour. Vol. xxxvii, p. 325.) The place of apparent radiation will doubtless be well determined from the ample materials obtained by the Prussian observers.

No returns from the southern hemisphere have yet been received.

E. C. Herrick.

5. *British Antarctic Expedition.*—The British Antarctic Exploring Expedition, under command of Capt. J. C. Ross, sailed from England in September, 1839. It consists of the *Terror*, of 340 tons, and the *Erebus*, of 370 tons, six guns each. They were built expressly for this purpose, and are finished and furnished in the most complete style at the expense of the Admiralty, under the superintendence of a committee of the Royal Society. The ships are in three compartments below, for greater safety. They are supplied with eight boats, two sets of all needed instruments, double decks, spare rudders, &c., together with abundance of pemmican, and fresh provisions for three years. The expedition is to establish magnetic observatories at St. Helena, the Cape of Good Hope, and Van Dieman's Land; thence to make for the Antarctic pole as far as possible. The highest latitude yet reached is 73° S., by Capt. Weddell in 1823.

6. *Compound Electro-Magnet.*—Messrs. Editors,—As the subject of electro-magnetism is now occupying much of the attention of the scientific world, and many experiments made to procure a motive

power, I would suggest what may be called a compound electro-magnet. I propose to have a series of circles, encircling each other to any definite extent required. I would after having formed a primary electro-magnet have it insulated on the outer surface; then place either a cylinder of iron or a succession of wires, until they have encircled the primary electro-magnet; then make a helix of copper wire in the usual manner; (I would prefer platinum wire to make the helix;) after having made a number sufficient to try an experiment, unite them by a plate of iron, either entire or in rims corresponding to each magnet. I also suggest the trial of brass cylinders over each successive electro-magnet to cut off the radiations of electricity; this will have either the effect to increase or decrease the magnetic power; experiments thereon must determine. Not having leisure to pursue the subject myself, I offer these suggestions for the public good through the medium of your highly valuable Journal.

Yours respectfully,

JONAS HUMBERT, Jr., Medical Electrician,
327 Broome St., New York City.

7. *Exchanges of American Shells and Insects.*

TO THE EDITORS—*Gent.*:—I have for several years spent much of my leisure time in collecting the fresh-water and land shells of this state, and have on hand a large number of species of Unio, Margaritana, (Alasmodonta,) Anodonta, Cyclas, Ancylas, Helix, Polygyra, Helecina, Pupa, Succinea, Cyclostoma, Planorbis, Physa, Lymneus, Melania, Anculosa, Valvata, and Paludina, which I am desirous of exchanging for such native and foreign species as are not in my collection. My shells are generally very perfect; the *Naiades*, which are mostly from the Scioto River and its tributaries, are remarkably so. I am particularly desirous of exchanging for native shells in the above genera, especially for native and foreign Naiades.

I am also collecting the Insects of this state, and would be pleased to exchange them for native and foreign *labelled* species.

I can label my shells with the names by which they are known to our western naturalists.

Either this fall or early in the spring I will do myself the pleasure of sending for your acceptance a suit of western shells.

I am respectfully, your obedient servant,

C. S. WARD.

Roscoe, Ohio, November 14, 1839.

8. *The Railway Magazine and Steam Navigation Journal. Edited by John Herapath Esq.* London. Published by J. Wyld. 8vo. Monthly.—This is a periodical work devoted chiefly to what is now

generally considered a highly important interest of society, viz. the means of a rapid locomotion. It is edited with much industry and ability, and must be of great value to civil engineers, and to all in any way engaged in railroads and steamboats, and it is not destitute of interest to the man of theoretical science. In the miscellaneous department we find an extensive range of scientific notices, and at the conclusion of every number, a table of the current prices of railroad stocks, with the original cost of each. The numbers average 88 pages each, and are sold at 1*s.* 6*d.* No. 37, which commenced the 6th volume of the new series, is dated March, 1839.

9. *To remove Carbonic Acid Gas from Wells, &c.*—Prof. HUBBARD, of Dartmouth College, writes: "Saussure, in his experiments upon the property possessed by ignited charcoal of absorbing gases, showed, that of carbonic acid gas, it absorbs 35 times its volume in 24 hours. Several years ago, I availed myself of this property in *purifying a well of carbonic acid gas*, and in my lectures have urged others to do the same, and the result in all cases of its use has been successful.

"As is well known, the extinguishment of a lighted candle in a well, if there be no odor, indicates the presence of carbonic acid gas. In this case, half a peck or more of ignited charcoal in a kettle should be let down by a cord nearly to the surface of the water. The glow is immediately deadened, *combustion ceases*, and the absorption of the gas begins. The lighted candle will show the progress of the experiment; in an hour the coal may be drawn up and reignited and let down again, and this repeated till the whole is removed. A well containing 8 feet in depth of the gas above the water was purified by two processes, and another with 26 feet of gas during an afternoon.

"The certainty of this remedy, and the facility with which it may be applied, give it a superiority over the ordinary modes of purification by explosion of gunpowder, &c."

10. *The Katakekaumene.*—Dr. Daubeny (Description of Volcanos) has quoted from Strabo a notice of the *Κατακεκαυμενη* near Smyrna. The term (from the Greek) implies—a region completely burnt by fire. Strabo says "it is without trees, with the exception of the vine. The surface of the ground is cindery, and the mountains and rocks are black as if they had been calcined. Some, he adds, have supposed the country to have been affected by fire from heaven, but it is most probable that so large a tract of country should have been burnt by fire from the earth."

Of this remarkable district Mr. Hamilton has given the following notice.

"*The Katakekaumene.*—The extent of this interesting tract is much less than is assigned to it in published maps, being not more than 7 miles from north to south, and 18 or 19 from east to west. After alluding to his first visit to it in company with Mr. H. E. Strickland, and referring to that gentleman's account of a portion of the district,* Mr. Hamilton describes minutely the two systems of volcanos, distinguished by the state of preservation of the craters and of the coulées; he defines also the course of each lava-current, and points out its attendant phenomena—but these details admit of only partial abridgment.

"The volcanic products are basalt, lava, and ashes, the first being confined to the more ancient craters, and the last to the more modern. The numerous older cones are further distinguished by being situated on parallel ridges of gneiss and mica slate, and the newer, only three in number, by being confined to the intervening alluvial valleys. This important distinction Mr. Hamilton explains on the supposition, that the elevation of the schistose ridges produced cracks, through which, as points of least resistance, the first eruptions of lava found vent; and that these openings becoming subsequently plugged up, by the cooling of injected molten matter, the schists were rendered so solid, that when the volcanic forces again became active, the lines of least resistance were transferred to the valleys.

"The coulées from the ancient craters appear to have been partly under water, as their surface is, in some places, covered with sediment and turf; but the lava streams from the modern are bare, rugged, and barren, and the craters are surrounded by mounds of loose scoriæ and ashes. In addition to the comparative view given by Mr. Strickland of the phenomena of the Katakekaumene and Central France, Mr. Hamilton enters into a more extended investigation of points of resemblance, including other portions of Asia Minor. The great volcanic groups of Mont Dore, the Cantal, and Mont Mezen, Mr. Hamilton conceives are represented by Ak Dàgh, Morad Dàgh, the trachytic hills east of Takmak, Hassan Dàgh, and Mount Argæus. The modern volcanic period of Central France he compares with the Katakekaumene, as respects the composition of the lavas, their arrangement at different levels, and the cones being scattered, not collected in great mountain masses. The Katakekaumene, in Mr. Hamilton's opinion, exhibits also additional evidence, that the disposition of comparatively recent volcanos is coincident with the strike of the granitic axis, from the interior of which the volcanos have burst forth. The author also alluded to other comparative phenomena noticed in Mr. Strickland's paper. Lastly, he pointed out two distinctions—in

* See L. & E. Phil. Mag. vol. x, p. 70.

Central France streams of igneous products may be traced from the most ancient volcanic masses of Mont Dore, but in Asia Minor none have been detected which could have flowed from Ak Dàgh, or Morad Dàgh. In France, also, trachytic eruptions occurred during the deposition of the lacustrine limestone; but in the Katakekaumene, they appear to have preceded that of the white limestone, or are associated with only its lowest beds.

"In conclusion, the paper gives a general summary of the geological phenomena of the country south of the Demirji range.

"The relative antiquity of the vast lake or sea in which the strata were deposited, cannot be determined, as the micaceous sandstone forming the lowest series of beds is apparently destitute of organic remains, and Mr. Hamilton, therefore, does not attempt to compare that deposit with any European formation. The sandstone, he conceives, was accumulated upon an irregular surface of schistose rocks and crystalline limestone, and before the elevation of the Demirji chain. Upon the sandstone were deposited in the north of the district the beds of peperite, derived probably from subaqueous volcanos; and upon the peperite and the micaceous sandstone, the white limestone, which is the highest sedimentary rock. The drainage of the lake, he is opinion, took place during the earliest volcanic eruptions of the Katakekaumene.

"Three well-defined periods of igneous operations may be traced. The first is marked by the masses of basalt which cap some of the plateaux of white limestone, and were ejected previously to the country assuming its present configuration, and to the formation of the valleys. Mr. Hamilton considers that the basalt flowed under water, and probably but a short time before the drainage of the lake.

"The second period is characterized by the currents of basalt and lava from the ancient system of volcanos in the Katakekaumene, and was subsequent to the formation of the present valleys, as many of the lava streams may be traced into them. The coulées which flowed towards the Hermus from the crater or Karadevit near Koola, present an inclined plane, the surface of which is not more than 150 or 200 feet above the present bed of the river; but they must, at one period, have been under water, as the lava is covered with a sediment which filled its crevices and smooths its asperities.

"The third period would be to the more modern system of cones, the lava of which is as rugged and barren as the recent coulées of Etna and Vesuvius. Of the date of these eruptions, Mr. Hamilton offers no opinion, merely remarking that the craters are mentioned by Strabo, and that there is no tradition of their activity."—*Lon. and Ed. Phil. Mag.*

APPENDIX.

MANUFACTURE OF PINS.

We have seen with great satisfaction the beautiful machine for the manufacture of pins invented by Dr. Howe.

Its operation is so like that produced by intelligence directed in the immediate movements by a specific purpose, and furnished with the organs (so to speak) adapted to fulfil its designs, that it perfectly imitates the human fingers, obeying the impulse of the mind.

The production of a perfect pin headed and pointed by one system of movements, is equally surprising and gratifying. The manufacture although of a small article, is also of national importance, and we therefore admit the reasonable statements of Dr. Howe, as an Appendix to this Number,—trusting that the publication may not be without effect upon the minds of those who form our commercial regulations, and determine the success or failure of our domestic manufactures.—*Editors.*

To the Editors of the American Journal of Science, &c.

Gentlemen—Agreeably to your suggestion, I take leave to communicate to you a few of the facts and circumstances connected with the attempt, in which I am engaged, to introduce the manufacture of pins, in our country, by the use of labor-saving machinery.

You are aware that in the manufacture of pins, in Europe, manual labor, for the most part, of the cheapest kind is employed; and, consequently, that any attempt to manufacture them, in this country, by a similar method, must inevitably fail, on account of the comparatively high price of labor here,—unless protected by a high import duty, or a prohibition of the importation of the article. During the war of 1812, when the supply from abroad was in a great measure cut off, pins were sold in this country at greatly enhanced prices.

A friend told me, recently, that he sold pins, at that time—at wholesale—for twelve dollars per pack, (of 12 papers—500 pins each) which is eight or ten times the present price. I believe thorns were very generally substituted for pins, both in the late war and during that of the revolution. According to the most probable estimate I can form from the information I have received, there are manufactured in Great Britain, at least, fifteen tons of pins per week,—about one fifth of which are supposed to be sent to the United States; and there are also larger importations to this country from the Continent. Considering the great quantity and value of pins used in this country—and their importance as an article of general use, and convenience, if not of necessity, it would seem reasonable that encouragement should be given to an attempt to manufacture them; or at least that no obstacle arising out of the past legislation of our government, should be allowed to remain in the way of such an undertaking. But it so happens that under the existing revenue laws of the United States, pins are, not only an unprotected article of manufacture, but to a certain extent, the making of them in this country is *prohibited;* inasmuch as that pins of foreign manufacture, are admitted free of duty; whereas, brass wire of which pins are made, is charged with an import duty of nearly twenty five per cent. It is obvious that the advantage is given to the foreign over the American manufacturer, by this state of our revenue law. Supposing the two to be on an equal footing in all other respects, it is sufficient to enable the former, effectually, to keep or drive the latter out of our markets. And supposing the use of labor-saving machinery should enable us for a time, to compete successfully with the foreigner, notwithstanding the *bounty* thus conferred upon him,—we have no reason to hope that machinery once successfully established here, will not speedily find its way into the hands of our foreign rivals, and be brought to bear upon us to the ruin of our prospects, unless we succeed in getting relief from our own government. A market, so important as that of this country for the article of pins, will not be given up without a struggle, by those who have had the exclusive benefit of it.

We have petitioned Congress, at the two last sessions for relief, without success; but being confident in the justice of our claim, it is our intention to renew our application at the ensuing session.

In reference to this object, my wish to have some notice of the undertaking appear in your well known and influential Journal, arises from a belief that information communicated through such a medium—founded partly on your own observation—would be more readily received and credited, than if communicated directly from parties interested, or conveyed through any ordinary channel. We cannot expect Congress to legislate for our relief, unless members are first convinced that there is some reasonable prospect that with such relief, our enterprise may succeed. We shall petition for a duty to be laid on pins, equivalent to that to which brass wire is now subject. In accordance with such a petition a bill was introduced, by Mr. Adams, from the Committee on Manufactures, at the last session, but it was not acted on in the House.

I believe ours is the first successful attempt to manufacture pins entirely by self-acting machinery. I am aware of other attempts having been previously made, but without success. Since we commenced, another establishment has been started in this country, and I understand is likely to succeed.

We have now three of the larger improved machines in operation, each of which produces about 24,000 pins per day. The intention of the Company is to put up fifty of them (in case we get the relief we seek from Congress,) which will produce about 2,000 packs (of 12 papers each,) per week; and the establishment might afterwards be enlarged, if the business afforded sufficient encouragement. I estimate that twelve persons (men and boys) would be able to keep fifty machines in full operation. But it would require the labor of one hundred or a hundred and fifty individuals, (women and girls,) to shut or paper the pins. At the present time we give the pins out into families to be shuted; we have fifty or sixty hands employed (more or leas steadily) in this department, some of whom reside ten miles from the manufactory.

Allow me to express my sincere thanks for the kind and liberal feelings manifested by you towards our infant establishment; and to subscribe myself,

Very respectfully and truly, yours,

JOHN I. HOWE.

Birmingham, (Derby,) Nov. 25, 1839.

Messrs. NESTLER & MELLE,

BOOKSELLERS, HAMBURG, GERMANY.

If any of our correspondents and friends wish to procure German Books, from Germany, we would take the liberty of recommending, as suitable agents for this purpose, Messrs. *Nestler & Melle*, as a house desirous of establishing business relations with this country, and as having shown prompt and kind attention to such commissions as we have had occasion to trouble them with.

—Eds. Am. Jour.

New Haven, Dec. 10, 1839.